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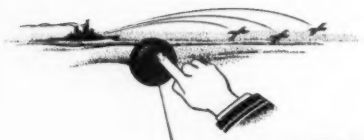

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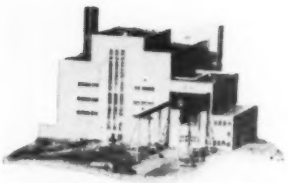

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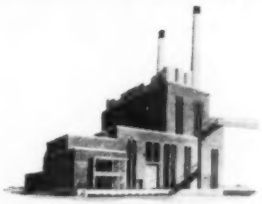

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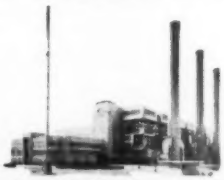

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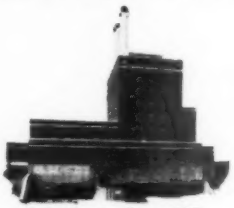

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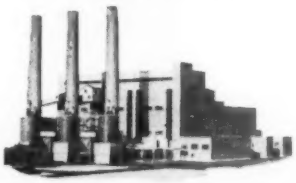

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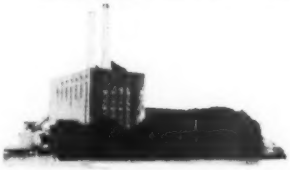

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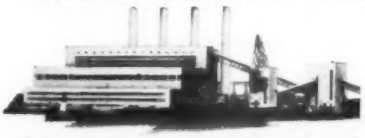

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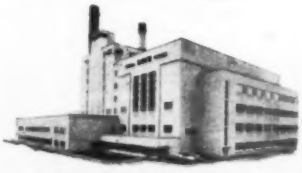

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10 OF THE TOP 15

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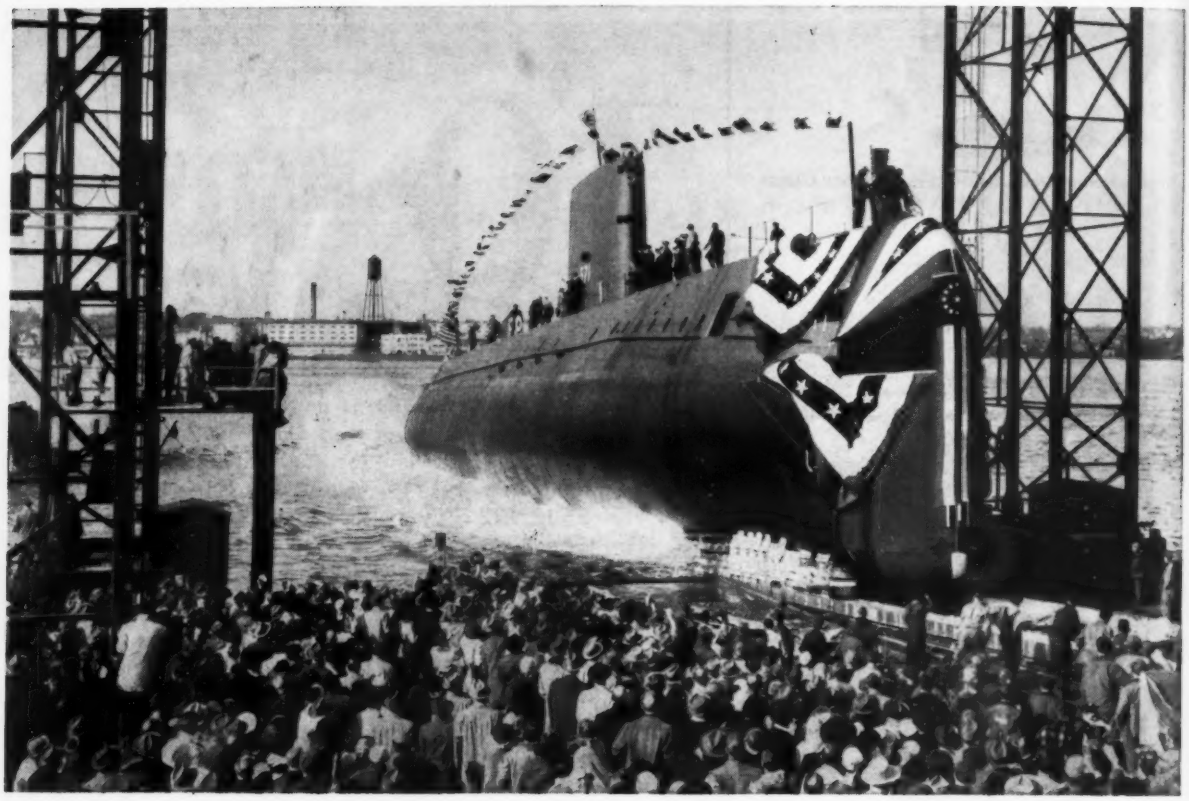

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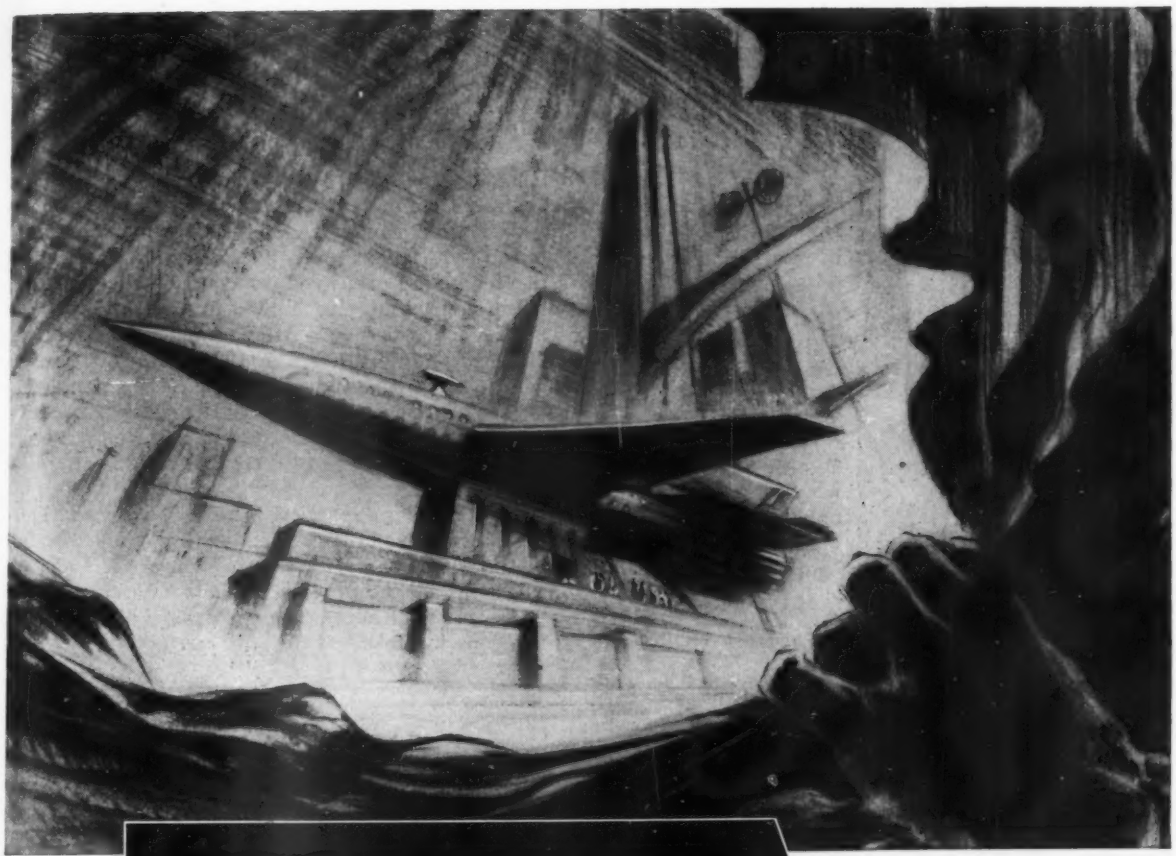
THE TABULAR VIEW

Technology's Architecture. – Since its founding in 1865, M.I.T. has occupied three different locations, each of which was marked by a totally different kind of architecture. In 1916 when M.I.T. moved to its new location in Cambridge on the Charles River and outgrew its nickname of "Boston Tech," the inspirational genius of Welles Bosworth, '89, provided the Institute with architectural surroundings which borrowed heavily from the classicism of Greece and Rome. By 1938, or thereabouts, structures of a modernistic type began to make their appearance on the Cambridge campus. As recorded by CAROLINE SHILLABER in the second of a two-part article (page 343) modernism in the architecture of M.I.T. buildings came into full bloom with the construction of new – and much needed – buildings in the postwar period. Certainly the new Kresge auditorium (now under construction) and the chapel (soon to be built) are as breath-taking in their architecture as Baker House, which has already seen several years of service as a student dormitory. A graduate of Smith College, Miss Shillaber is librarian of the Arthur Rotch Memorial Library of Architecture at M.I.T.

Perpetual Life? – JAMES A. TOBEY, '15, a frequent contributor to The Review on matters of public health and related topics, takes time out from a busy life to discuss (page 349) the possibility of extending man's life span beyond the Biblical "three score and ten" years. In his present article, Dr. Tobey is not concerned with the reasons one might give for wishing to live to be 100 years old or more; he is satisfied merely to draw whatever conclusions are reasonable concerning the possibility of achieving this end. Much progress has already been made in overcoming mortality among infants and children. Moreover, history records many cases of those whose life span has extended a full century. Now that more attention is being directed toward the diseases of middle life and old age, may we not expect a significant lengthening of the average life span? Dr. Tobey received the S.B. and Dr.P.H. degrees from M.I.T. in 1916 and 1927, respectively. He received the LL.B. degree from Washington Law School in 1922, and the M.S. degree from the American University in 1923.

Webster Lecture. – PROFESSOR ARNOLD TUSTIN, distinguished British engineer and Head of the Department of Electrical Engineering at the University of Birmingham, England, is the first visiting professor to occupy the Webster Chair of Electrical Engineering at M.I.T. In this capacity, Professor Tustin delivered the inaugural lecture of the Webster professorship which The Review is pleased to bring to its readers (page 351). In his Webster lecture, Professor Tustin urges that the university of the future be primarily concerned with the training of well-rounded, competent individuals who will be willing and able to apply their knowledge for the benefit of

(*Concluded on page 334*)



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THE TABULAR VIEW

(Concluded from page 332)

mankind on a global scale. He believes that electrical engineers can make an important and significant contribution in this field. As if to prove his point, Professor Tustin has recently published a book in which the feed-back principles, so commonplace in electrical engineering, are applied to examine our overall economic system. After graduation from the University of Durham in 1920, Professor Tustin gained extensive and varied experience in the electrical manufacturing industry. He played an active part in those developments leading to the adoption of 1,500- and 3,000-volt direct current as standard voltages in transportation systems which made possible the modern lightweight trolley-bus motor. During World War II he was active in the development of the Metadyne, a method of control for such applications as the automatic aiming of anti-aircraft guns, and in the development of gyroscopic stabilizers for guns in tanks.

MAIL RETURNS

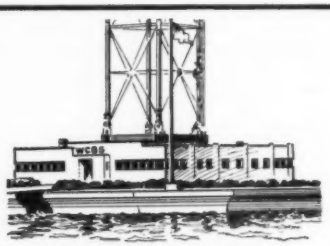
Old Rogers

FROM WILLIAM R. GREELEY, '02:

Historic styles in architecture are of academic interest only, but to keep the academic record straight, dear old "Rogers" (page 299, April, 1954, issue of The Review) is not Greek revival but Renaissance (English-French-American).

The article is very interesting and promotes nostalgia. Next to Engineering C was a small building called "The Tech Union," the first social building. Is there a photograph of that anywhere? I was the architect and didn't get a picture and it was soon demolished. I'll bet it was terrible.

Boston, Mass.



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GOODYEAR

LifeGuard, T. M.—The Goodyear Tire & Rubber Company, Akron, Ohio

Detail of Park Street Church (April Contents page), at Tremont and Park Streets, Boston, is regarded as one of the finest brick and glass structures ever built.

Raymond E. Hanson

How Well Do You Know Boston?

Shown here are memorials from two wars in which our nation was engaged. Can you identify them and give their location? If not, see Contents page for next month.

THE TECHNOLOGY REVIEW

TITLE REGISTERED, U. S. PATENT OFFICE

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

CONTENTS *for May, 1954*

Vol. 56, No. 7

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"BIG BOY" • *Photograph by Ward Allan Howe* ..... THE COVER
Steam locomotive on the Union Pacific, in Wyoming

OLD MILL AND DAM AT WEARE, N. H. • *Photograph by Raymond E. Hanson* ..... FRONTISPIECE 338

ARCHITECTURE AT M.I.T., PART II ..... BY CAROLINE SHILLABER 343
Inaugurated about 1938 the modern era in M.I.T. architecture lives side by side with the classical

IS THERE A LIMIT TO HUMAN LIFE? ..... BY JAMES A. TOBEY 349
Now that life expectancy, at birth, exceeds half a century, we may well ask whether the average life span need be limited to seven or eight decades

ELECTRICAL ENGINEERING IN A NEW KIND OF UNIVERSITY
BY ARNOLD TUSTIN 351
"Let us wholly accept . . . the global problem of applying all our knowledge and understanding to the betterment of the human future"

THE TABULAR VIEW • *Contributors and Contributions* 332

MAIL RETURNS • *Letters from Review Readers* 334

THE TREND OF AFFAIRS • *News of Science and Engineering* 339

THE INSTITUTE GAZETTE • *Relating to the Massachusetts Institute of Technology* 355

Published monthly from November to July inclusive on the twenty-seventh of the month preceding the date of issue, at 50 cents a copy. Annual subscription, $3.50; Canadian and foreign subscription, $4.00. Published for the Alumni Association of the M.I.T.: Horatio L. Bond, President; H. E. Lobdell, Executive Vice-president; Dwight C. Arnold, Richard S. Morse, Vice-presidents. Donald P. Severance, Secretary-Treasurer. Published at Hildreth Press, Inc., Bristol, Conn. Editorial Office, Room 1-281, Massachusetts Institute of Technology, Cambridge 39, Mass. Entered as second-class mail matter at the Post Office at Bristol, Conn.

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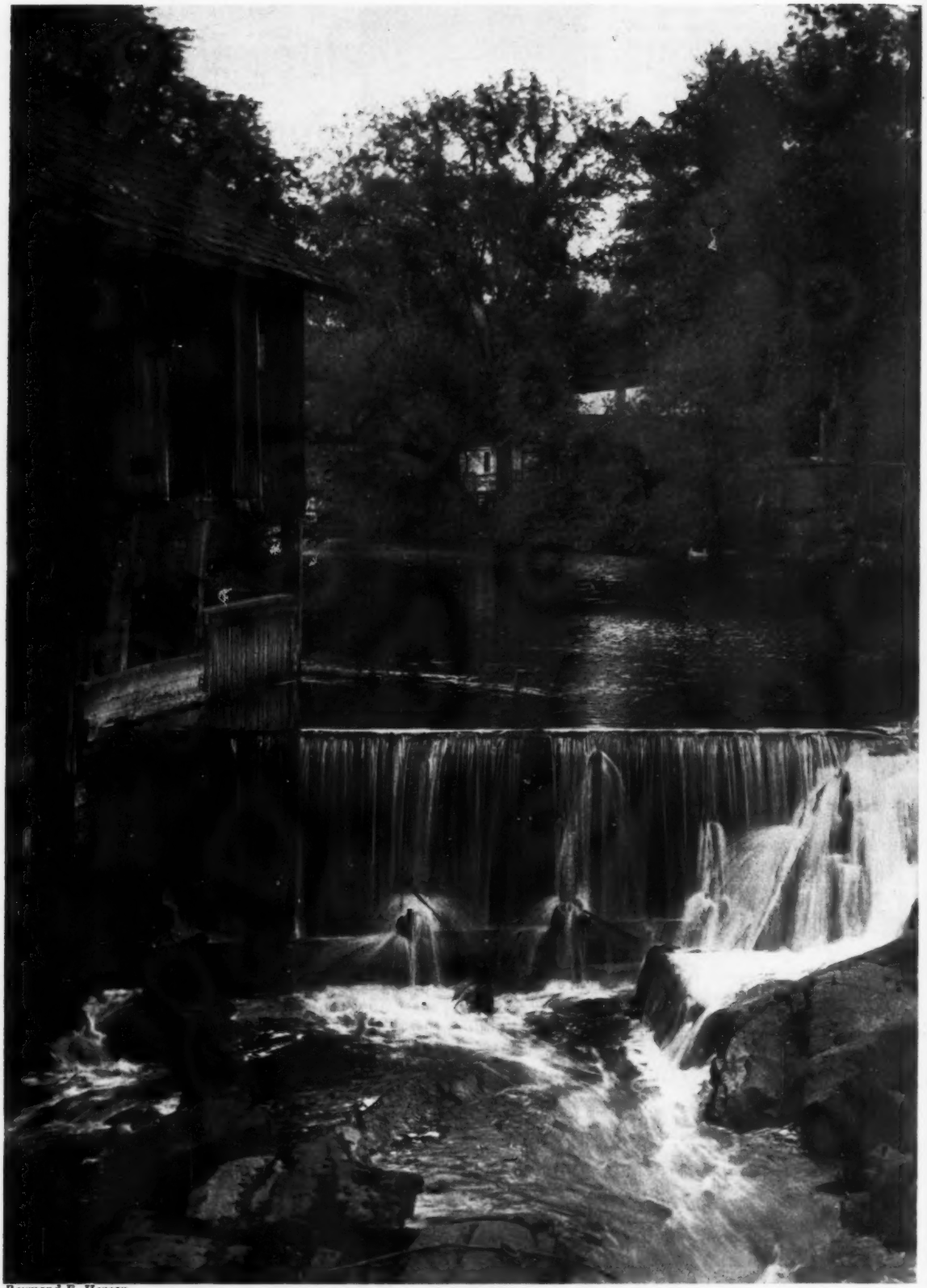


Raymond E. Hanson

Old Mill and Mill Dam

Reminiscent of an earlier era in American technology, this ancient structure at Weare, N.H., retains the charming dignity of peaceful simplicity.

THE
TECHNOLOGY
REVIEW

Vol. 56, No. 7 May, 1954

The Trend of Affairs

The Iceman Comes

NOWADAYS the iceman comes mostly just to deliver ice cubes and crushed ice. The cooling for which he used to deliver large ice cakes is generally provided today by mechanical refrigeration. But ice in cube or crushed form is still needed to chill beverages. Also crushed ice is used to refrigerate a few foods, principally sea foods, that keep better in contact with ice than they do when placed in mechanical refrigerators.

Ice cubes are delivered to the consumer sometimes in covered fiberboard drums or closed paper bags, more often in bulk. Crushed ice is generally prepared by grinding ice cakes – usually the standard 300-pound size – through a power-driven chipping machine attached to the delivery truck. Crushing is customarily done on the street, in front of each customer's doorway. Crushed ice and bulk ice cubes are carried into the customer's premises in cloth bags, or in barrels or buckets of wood or metal.

These operations, of crushing ice and delivering crushed ice and ice cubes, are an everyday sight on city streets. Anyone having a sanitary point of view witnesses them with some alarm; for they are usually done with a casualness such as one expects to see in the handling of coal or such a commodity; certainly these operations are not conducted with the care and cleanliness appropriate in the handling of any material intended for human consumption.

Alarm is magnified when one observes the placing of ice in glasses in some restaurants, soda fountains, or bars. Often the fingers are employed; there is a temptation to do this because the ice is troublesome to handle with any implement. Scoops may be used; but they often are grasped so that the hand comes in contact with the ice in the bin, that in the scoop, or with both.

Recently published reports show that concern over the sanitary quality of ice cubes and crushed ice is far from groundless. Numerous samples of such ice, taken at the point of consumption, were found to be heavily contaminated with bacteria, including fecal types and others usually indicating pollution of human origin. Quantities of foreign materials were found among the ice; sand, clay, fibers, threads, bits of finger nail polish, insect fragments, rodent hairs, and wood splinters.

Where does this contamination originate? In commercial ice plants, ice is manufactured from drinking water of uniformly high sanitary quality. The plants themselves are operated in a sanitary fashion, under supervision of local health departments. Hence it follows that the pollution found in cube and crushed ice resulted from abuse during crushing, delivery, and dispensing.

Although it is true that no outbreaks of disease have been traced to contaminated ice, there is potential danger whenever bacterial contamination, especially of fecal types, exists in material entering the human digestive tract. Moreover modern public health philosophy holds that the consumer is entitled to foods and beverages delivered in such a way as to be free from extraneous materials.

It is reassuring to learn that steps have been taken through two different approaches to eliminate contamination of cubed and crushed ice. The first approach is that of education; by showing icemen, restaurant employees and others involved in handling it, how to handle ice so as to avoid pollution of foodstuffs.

The other approach is chlorination of ice at the point of use. Sodium hypochlorite is used to prepare a stock solution. The ice cubes or crushed ice are covered with water to which the stock hypochlorite solution has been added in a proportion to establish

a chlorine level of two parts per million. Bacterial contamination is effectively destroyed; and beverages chilled with such ice are free of detectable chlorine flavor or odor.

Elements in the Earth's Crust

GEOCHEMISTRY is concerned primarily with the chemistry of the earth. One of its principal tasks is to provide a basis for determining the way in which elements are distributed in specific geological materials, such as rocks, for example. In part, the problem is a statistical one which can be answered only by analyzing many specimens of a given type of rock from a fairly large area. Determination of the distribution of elements in geological materials is not only of considerable scientific interest, but also has technological utility in exploring and evaluating possible ore reserves more efficiently than has been possible.

One prime goal of the research in geochemistry carried out by Louis H. Ahrens, Assistant Professor of Geology, and his co-workers in the Department of Geology and Geophysics, and supported, in part, by the Office of Naval Research, has been to establish the statistical nature of the distribution of elements in rocks and minerals. For this investigation, a dozen elements have been determined spectrographically in many specimens of igneous rock from New England and Canada. In all, some 812 quantitative observations have been made. As shown in Fig. 1, the frequency distribution plots of each element assume positive skewness when plotted in the usual manner, and hence the distribution is not the normal or Gaussian one. The distribution takes on the normal or Gaussian form, however, if the logarithm of the concentration of an element is made the variate, as shown in Fig. 2. A plot such as that shown in Fig. 2 is called a lognormal plot.

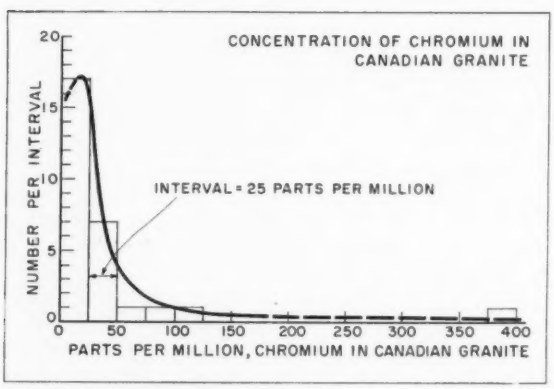


Fig. 1. Linear plot of concentration of elements in rocks and minerals results in positively skewed curve of frequency distribution. In the past, it has been usual practice to make plots with linear abscissas.

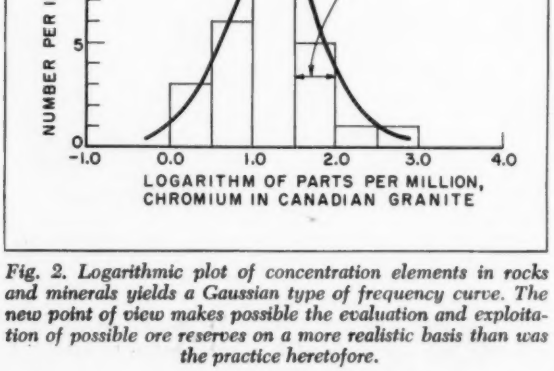


Fig. 2. Logarithmic plot of concentration elements in rocks and minerals yields a Gaussian type of frequency curve. The new point of view makes possible the evaluation and exploitation of possible ore reserves on a more realistic basis than was the practice heretofore.

The Gaussian distribution for the logarithmic plot has been found to hold for all elements, and leads to an enunciation of a fundamental law of geochemistry, namely, the concentration of an element is lognormally distributed in specific igneous rocks.

Some interesting consequences arise from this fundamental law. The new point of view enables us to compare and predict the dispersion, or variation of concentration, of elements. Some elements, of which gallium is a good example, show extremely small variation, whereas others, such as chromium, show enormous variation. Moreover, the new law tell us that, in geological materials, the abundance of an element (as given by the arithmetic mean of all determinations) is always greater than the most frequent concentration, as given by the geometric mean. The difference is variable and is determined solely by the magnitude of the dispersion.

The fact that elements are lognormally distributed makes possible the evaluation and exploration of possible ore reserves more efficiently and on a more realistic basis than has previously been possible. For example, the large potential gold field in the Orange Free State is being surveyed by the new technique.

Castings as Good as Forgings?

ALUMINUM, in many forms, finds its way into almost limitless engineering applications, not the least of which is modern aircraft. On a tonnage basis, wrought aluminum represents today the lion's share of this engineering material; but castings are playing an ever increasing role which would, no doubt, double or triple almost overnight if the mechanical properties and soundness of aluminum castings were better and more dependable. It is to this end the foundry staff at M.I.T. has been working the last three years; the work is being done under contract between Frankford Arsenal, a unit of the United States Army, and the Institute's Division of Industrial Coöperation.

When engineers design aircraft, factors of safety are used for materials under high stress to insure against premature failure from some undetectable flaw in the material. For wrought aluminum, this factor is 1.5, and for castings considerably higher, sometimes as high as 3.0; this reflects a serious but not wholly inexplicable shortcoming of castings. While the original ingot from which wrought products are made is a casting, the squeezing and shaping inflicted upon this ingot in its travel through the rolling mill have the beneficial effects of (1) closing and welding any porosity present, (2) refining the grain structure,

and (3) breaking down and distributing any nonmetallic impurities which might be present, thus rendering them less harmful. A casting is used without these benefits of densification, breakdown of nonmetallics, and grain refinement. Thus imperfections reflect in full force upon the properties of engineering items made from castings. Reasons for these imperfections have not been clearly understood in the past, and in foundries, where castings are made, there has been poor control over the means of minimizing imperfections.

The search for factors responsible for the disparity in mechanical properties between cast and wrought aluminum has led directly to fundamental studies of the kinetics of alloy solidification. Of particular interest are the compounded ill effects of dissolved hydrogen, solidification shrinkage, and adverse mechanism of freezing on the size, shape, and distribution of microporosity in cast structures. Most aluminum alloys (1) exhibit a pronounced dendritic or "mushy" mode of solidification which drastically promotes the incidence of microporosity, (2) are capable of dissolving hydrogen from the air, the mold, or other sources of water vapor, and (3) suffer a large volume change (shrinkage) upon solidification. The situation is such that currently prevailing foundry techniques are unlikely to produce sand cast metal having even 60 per cent of the potential strength of some aluminum alloys. Complicating the picture is the fact that the degree of porosity required to halve the strength of an aluminum alloy may be invisible on a machined surface – the metal looks "sound."

Having isolated and evaluated the problems involved, the work at M.I.T. has proved castings can be controlled to yield mechanical properties fully equal to those of wrought material of the same composition. By controlling gas content of the molten metal, using controlled but fully practical molding materials and methods, and by designing the casting so it will freeze under conditions of favorable thermal gradients, the optimum properties can be obtained as shown in the table. These properties are equal to those of wrought aluminum of the same composition, even though the metallurgical grain size of the cast metal averages from 0.2 – 0.4 millimeter as compared to 0.1 millimeter for its wrought counterpart. Properties shown for castings have been obtained from metal cast under favorable, but fully practical conditions; values for wrought materials are taken from the *American Society for Metals Handbook*.

Property	Wrought Metal	Cast Metal
255 (95.5% Al; 4.5% Cu)		
Tensile strength in p.s.i.	58,000	55,000
Yield strength in p.s.i.	37,000	37,000
Per cent elongation	19	12
755 (90.4% Al; 5.5% Zn; 2.5% Mg; 1.6% Cu)		
Tensile strength in p.s.i.	82,000	78,000
Yield strength in p.s.i.	72,000	72,000
Per cent elongation	12	5
275 (95.46% Al; 4.5% Cu; 0.04% Sn)		
Tensile strength in p.s.i.		63,000
Yield strength in p.s.i.		52,000
Per cent elongation		8

Current work comprises translation of this knowledge into practice so the aluminum alloy casting of the future will be a more dependable, high quality, engineering material. Thus, perhaps the sometimes lowly casting may yet merit, attain, and maintain its rightful place in engineering design.

The project is under supervision of Howard F. Taylor, 2–46, Professor of Metallurgy, and Clyde M. Adams, Jr., '49, Assistant Professor of Metallurgy. Michael B. Bever, '42, Associate Professor of Metallurgy, has acted as adviser to the project since its inception. William D. Walther, '50, Denis W. G. White, and George D. Chandley, '53, doctorate candidates in Metallurgy, are currently working on this project; Merton C. Flemings, Jr., '51, a recent doctorate student, conducted his thesis research in this field.

Energy and the Atmosphere

ENERGY flowing at the rate of several hundred billion horsepower from the day-to-day storms of our weather generates the great prevailing winds – such as the trade winds and jet streams – which encircle our globe. This conclusion, which upsets earlier theories of how the world-wide motions of the atmosphere are maintained, comes from a long-term research project in the Institute's Department of Meteorology. In due time, the M.I.T. meteorologists say, this new theory may take some of the uncertainties out of long-range weather forecasting.

Global wind statistics have been assembled and analyzed during the past five years by a team under the direction of Victor P. Starr, '38, Associate Professor of Meteorology, and including Edward N. Lorenz, '43, and Hsiao L. Kuo, staff members of the Division of Industrial Coöperation in the Meteorology Department, and Robert M. White of the Air Force Cambridge Research Center, which through its support made this project possible.

Their conclusion proposes, in effect, that the world-wide motions of the atmosphere are driven by what might be described as many small "heat engines." "These engines," says Professor Starr, "are the great storm areas which bring our day-to-day weather changes; their energy comes from the interaction of warm and cold air masses.

"As an effect of the earth's rotation," he continues, "this energy is then so organized as to be fed into and to maintain the zones of prevailing west and east winds which would otherwise die down because of friction. The rate at which energy is thus fed into these prevailing wind systems turns out to be several hundred billion horsepower."

According to Professor Starr and his associates, practically all of the traditional pictures have shown the atmosphere operating as a single huge heat engine. That is, the air has been generally considered as rising at latitudes near the equator and then at high altitudes moving toward the poles, with the return current flowing near the ground. The prevailing westerlies and easterlies were then explained as an effect of the deflecting force of the earth's rotation. The new theory means that the prevailing winds are in fact the result of the high and low pressure areas they carry across the land – a complex interrelationship of forces larger than any man has ever reproduced.

The M.I.T. research team studied wind measurements recorded routinely at over 250 weather stations thoughout the Northern Hemisphere – in the United

States, Canada, and Alaska, Europe, Africa, Asia, and ships at sea.

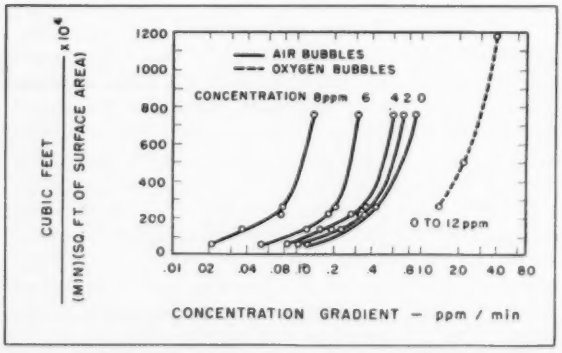
This information comes from free balloons released at these weather stations at frequent intervals, daily when possible. Some of these balloons carry radio equipment to report their information; others are followed from the weather stations by radar. The best of these balloon records show the winds in the various layers up to 10 miles high – through more than 90 per cent of the earth's atmosphere and its weather.

The raw material for the statistical studies at M.I.T. came from daily wind measurements made over more than one year's time, in more than 40,000 balloon ascensions – a total of about 200,000 wind measurements at different levels up to 10 miles, showing wind velocities up to 200 miles per hour. This kind of information about winds aloft, the M.I.T. group points out, has been available on a wide scale only since about 1949. Before that, not enough stations were equipped for measuring winds at high levels, and some of the techniques were practically unknown before World War II.

"Long-range weather forecasting," says Professor Starr, "requires knowing weather over an entire hemisphere. Thus this fundamental knowledge of the sources of our prevailing winds should contribute to more accurate long-term predictions. This same knowledge may help us to form theories which will clarify the behavior of the more localized weather phenomena which make up day-to-day weather."

Aeration Studies

One of the important methods employed for the treatment of sewage and industrial wastes is the activated sludge process. This type of treatment involves the aeration of organic wastes in an aeration tank by means of air bubbles generated from porous aluminum oxide diffuser plates located near the bottom of the tank. These bubbles serve the double purpose of providing dissolved oxygen to sustain the bacteria which feed on the gelatinous activated sludge and tank contents. In present aeration practice, the compression requirements for release of these air bubbles constitutes a major proportion of the total operational costs for plants of this type, and large volumes of air are needed to provide sufficient dissolved oxygen.



Gas flow requirements for maintaining a given initial concentration as a function of concentration gradient for air and oxygen bubbles.

In order to provide a more fundamental understanding of the mechanism of diffusion of oxygen from gas bubbles with the aim of securing greater efficiency in the solution of oxygen, since 1949 the National Institutes of Health, United States Public Health Service, has sponsored a program of basic research at the Hydrodynamics Laboratory of the Department of Civil and Sanitary Engineering, to accomplish these objectives. The investigation is under the direction of Arthur T. Ippen, Professor of Hydraulics, with the assistance of Charles E. Carver, Jr., research assistant.

The design of the experimental equipment is such that the primary variables involved in the aeration process, in other words, gas flow rate, bubble size, and liquid depth, may be accurately controlled. Bubbles ranging in size from 1.25 to 2.50 millimeters in diameter were dispersed through glass capillary tubes into a lucite column filled with tap water to various depths. The water is initially deaerated by circulation under vacuum, followed by "stripping" with nitrogen bubbles. Air or oxygen bubbles are then introduced through the capillary diffusers and the test is complete when the column becomes saturated with dissolved oxygen. The concentration of oxygen is determined by the standard Winkler test, as well as through the use of a continuously-recording oxygen meter utilizing either a dropping mercury electrode or rotating platinum electrode. The rate of rise of the bubbles is recorded and the bubble sizes are determined photographically.

Rates of oxygen absorption and absorption coefficients have been determined for a number of combinations of gas flow rate, bubble size, and water depths using both air and pure oxygen bubbles. It has been found that, for a given depth and diffuser, the amount of oxygen which is absorbed by the liquid is higher for lower gas flow rates than for higher ones. The use of an increased number of diffusers (to keep the flow rate per diffuser at a low value) is therefore desirable for higher flow rates in actual plant operation. The test data also indicate that for a given rate of gas flow the absorption per foot of column length is higher for lower depths than for higher ones. Since the diffuser head loss is fixed irrespective of water depth, the over-all efficiency will generally increase with increasing depths until diffuser losses are materially reduced in comparison to total compression requirements.

For a given rate of gas flow, greater absorption rates are obtained with small bubbles owing to the increased surface area available for oxygen transfer. For bubbles in the Stokian range the per cent absorption varies inversely with the cube of the bubble diameter. Ultimate increases in aeration efficiency must be looked for from methods of producing smaller bubbles with minimum power expenditure.

A practical application of the test data is shown in the accompanying figure from which the gas flow requirements for maintaining a desired concentration level of dissolved oxygen may be obtained in an aeration tank subject to a given concentration gradient or oxygen demand. The figure also clearly defines the range of concentration gradients which may be satisfied by aeration procedures.

Architecture of M.I.T. Buildings

Shortly before the Outbreak of World War II a New Era of Building and Expansion Was Begun to Meet the Institute's New Educational Needs

By CAROLINE SHILLABER

Part II

In Part I of Miss Shillaber's article, which appeared in the April, 1954, Review, she described the architectural style of the early M.I.T. buildings in Boston and the first ones to be erected in Cambridge. Part II, presented below, discusses the architecture of the Institute buildings beginning in the late 1930's.

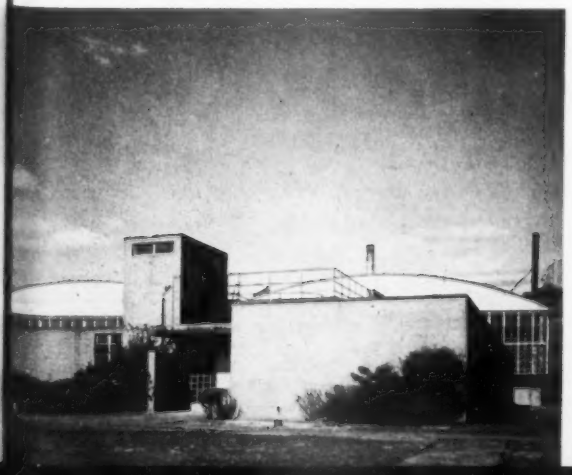
A NEW era in M.I.T. architecture was inaugurated about 1939 when the firm of Anderson and Beckwith began designing a series of laboratories and other buildings. By a careful plan of interior to provide maximum use with economy of space and maintenance, and by a thoughtful use of color that is a pleasant contrast to the usual monotone of academic walls, the newer buildings are distinguished by a form that is simple and unadorned. Lawrence B. Anderson and Herbert L. Beckwith are graduates from M.I.T. in 1930 and 1926, respectively, and both teach in the School of Architecture and Planning where Professor Anderson is also head of the Department of Architecture.

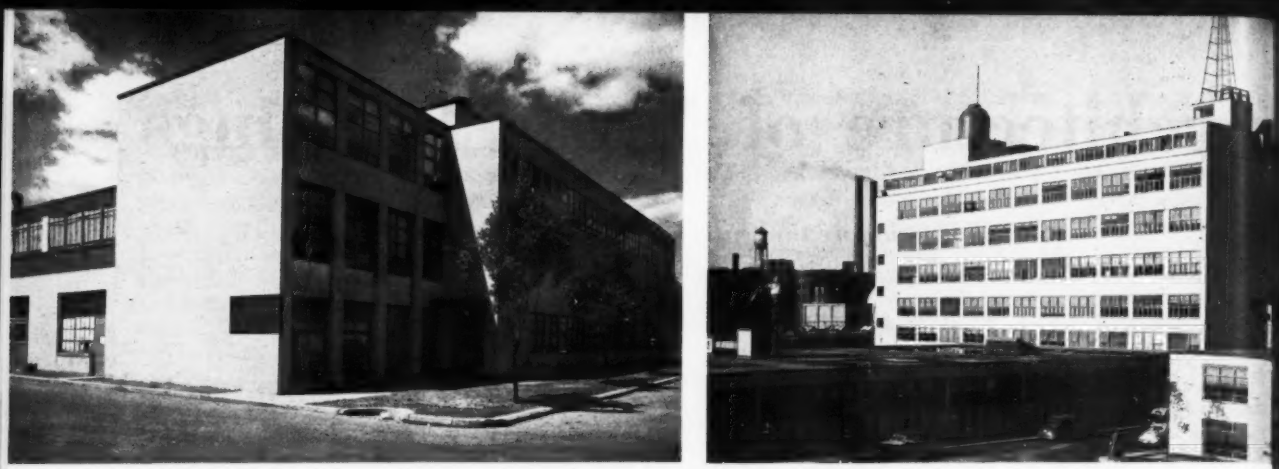
The eminently practical and serviceable Frank Harrison Briggs Field House put up in 1939, under a program for athletic and recreational facilities sponsored by the Alumni Association, was the first M.I.T. structure to be built according to designs of Anderson and Beckwith. Adjacent to the playing fields west of Massachusetts Avenue, it has a dark finish and angular shape that well symbolize strength and durability. Rooms, services, and lighting are expertly planned to provide pleasant and convenient accommodation for 432 men, with special quarters for visiting teams.

The following year Anderson and Beckwith built the Alumni Swimming Pool for the use of students and staff. In honor of their contribution to further expansion of athletic facilities, the pool is named for Technology Alumni. This is a fine looking building cleverly oriented; its southern wall is a huge window enabling the sun to shine on the entire water surface during the winter months. In addition to the pool of standard collegiate size (42 x 75 feet), there is a smaller, shallow practice pool (20 x 40 feet). There is also a gallery for more than 300 spectators and, of course, the necessary shower and dressing rooms. The color scheme of the interior in shades of pale yellow and blue is particularly successful, for it gives warmth to a building that would otherwise seem cold and cheerless. There is a small enclosed garden for sun-bathing on the south side of the pool.

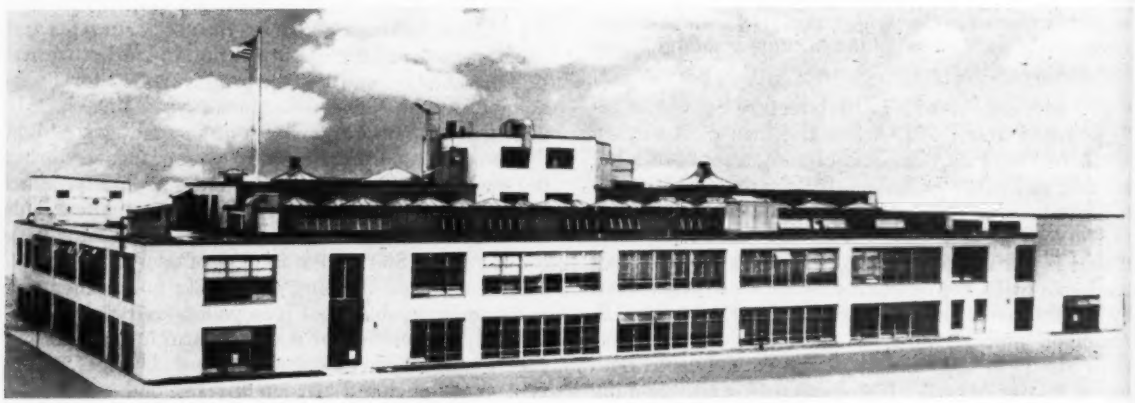
The Sloan Laboratories for automotive and aeronautical engineering were also built in 1940 to provide additional space for studies which had been carried on in a smaller structure. The new laboratories are a fine example of contemporary design applied to utilitarian purposes. The smooth exterior of light brick is unadorned except for a black plaque indicating the nature of activities housed in this two-story building, which is constructed so that additional stories can be superimposed on the present structure. Except for

As part of a program to provide M.I.T. students with adequate athletic and recreational facilities, the Alumni Association sponsored the Frank Harrison Briggs Field House (left) *erected on the East Campus in 1939, and the Alumni Swimming Pool* (right) *built on the West Campus in 1940*





Sloan Laboratories for automotive and aeronautical engineering (left) *were completed in 1940. The six-story building at the right was built during World War II to house the Radiation Laboratory, but Building 24 is now occupied by the Department of Geology and Geophysics and the Department of Meteorology. It also houses the Accounting and Payroll Offices and the headquarters of Buildings and Power.*



Originally constructed during World War II for research activities connected with the Chemical Warfare Service, this long low structure, known as Building 12, houses the Department of Chemical Engineering.

one wall, which serves as exhibition area, ample windows furnish daylight throughout the building. Interior brick walls are painted with colors that brighten the rooms without producing glaring surfaces.

During World War II the Institute's needs for increased space for research on defense projects suddenly expanded. To meet the demands of the technical and administrative staffs of the Radiation Laboratory, a combination laboratory and office building was begun in 1942. The more imposing portion of Building 24 is a six-story building used for laboratories and offices, although a one-story wing was provided for heavy equipment. From the first, the building was planned so that it might be easily con-

Westgate is the name given the community of married students who first came to M.I.T. in large numbers after World War II and for whom these bungalow-type buildings were erected.

verted in the postwar period into peacetime use for the Institute's normal educational requirements. The structure is of light colored brick, harmonizing well with the older limestone buildings. At present, Building 24 is occupied by the Department of Geology, the Department of Meteorology, and miscellaneous offices serving the Institute.

Designed originally to house wartime research activities of the Chemical Warfare Service, a long, one-story building of yellow brick was built during World War II to harmonize with Building 24. This structure, known as Building 12, now furnishes excellent laboratory and office facilities to the Department of Chemical Engineering.

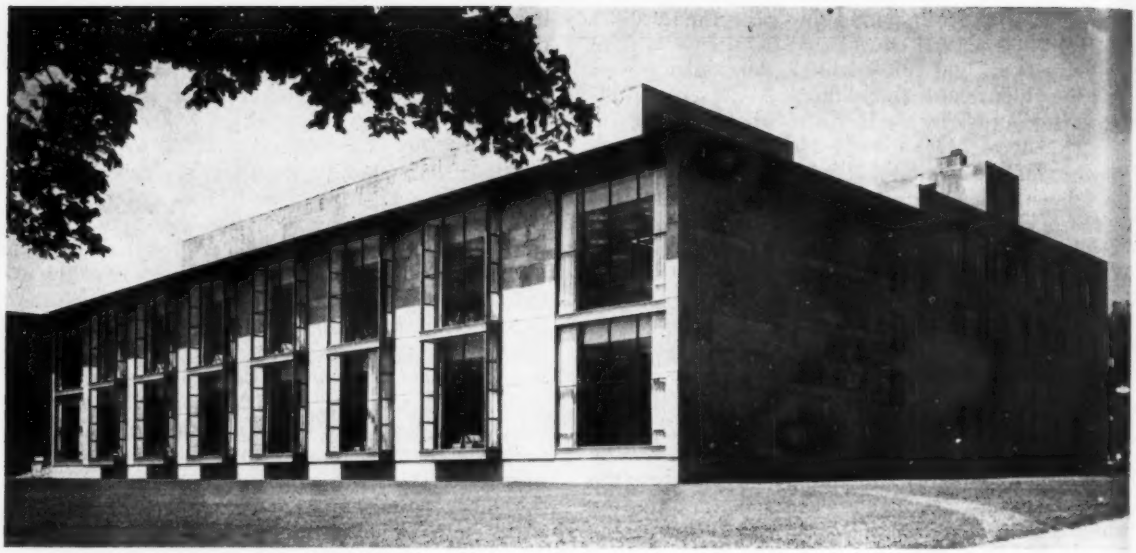
In 1945 the Richard M. Homberg Infirmary was remodeled by Anderson to incorporate features of clinical care and examination which the Institute's growing personnel required. The Infirmary (built in 1928 by Carlson) is a four-story structure joined directly to the academic group; it forms an inconspicuous north wing which is concealed from Massachusetts Avenue by the Rogers Building. This excellent medical unit, whose facilities have benefited so many, was given largely by the family of Richard M. Homberg, '23, who died while a student in his senior year.

The termination of war in 1945 – with subsequent enrollment of large numbers of married veterans – created a student housing shortage that M.I.T. met by constructing a group of one- and two-family cottages in an experimental project. Planned by William W. Wurster, '17, formerly Dean, and other members of the School of Architecture and Planning, with the co-operation of the Department of Building Engineering and Construction, Westgate was designed to house married students and their families. Nearly 100 houses were put up on 10 acres of land on Memorial Drive west of Massachusetts Avenue.

In 1949, Alvar Aalto, a visiting professor from Finland, was asked to draw plans for a new dormitory. Aalto ranks among the foremost exponents of the contemporary style that has not yet been generally accepted in conservative New England. The originality of his contribution to American architecture is evident in the fresh solution to the problem of student housing and pleasing design adopted for Baker House. This new dormitory is a graceful addition to the row of buildings along the Charles River. The new dormitory ripples like a gigantic capital M, in order, as Aalto said, to provide more rooms on the same lot than could be placed in a straight line, and so that all rooms would face upstream or down. The texture of the exterior walls is crisp due to the use of handmade bricks that catch the sun in light and dark nubbins in a vivid effect that emphasizes the curved lines of the building. The main doorway of Baker House, facing the athletic field and away from Memorial Drive, is protected by a low canopy that is plainly intended as a passageway rather than as a meeting place. Glassed-in exterior stairs are hung on the north wall of the dormitory, permitting a freer scheme of corridors that widen into lounges with increasing width on each floor. A dining extension of contrasting stone faces the Charles River and is ingeniously lighted by a series of domes which admit sunlight during the day and provide artificial lighting at night. A clever arrangement of space, that places nearly all rooms on the south or river side where they have direct sunlight, is used for the interior of the dormitory which is planned for 353 students. The single, double, or triple rooms are of assorted sizes and shapes, due to the serpentine plan of the building. Inviting lounges are located on the upper floors. All furniture, except chairs, is built-in and was designed by Aalto in collaboration with his wife, Aimar Aalto.

Much credit is due to the firm of Perry, Shaw and Hepburn, associate architects, who completed construction of the dormitory after Professor Aalto returned to Finland. The dormitory was named Everett Moore Baker House in honor of a former dean of students at the Institute.

Named for the late Everett Moore Baker, Dean of Students, the Baker House dormitory provides accommodations for 353 students. Each of its rooms looks across Memorial Drive and the Charles River, toward Boston.



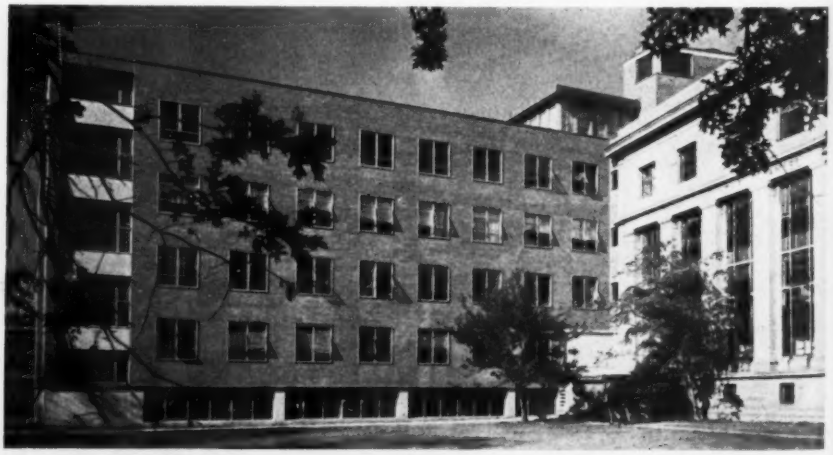
Although not part of its own academic group, M.I.T was directly concerned with a unique apartment house built in 1948 on land leased by the Institute to the New England Mutual Life Insurance Company for an apartment building. This project, Eastgate, or 100 Memorial Drive, was the first venture into the field of housing by the Company. It was planned by William H. Brown, '33, and other members of the School of Architecture and Planning, at M.I.T., including Carl Koch, Robert Woods Kennedy, Vernon DeMars, and Ralph Rapson. A narrow building shaped like a capital F was oriented, on a site beyond the eastern end of the campus, to provide every living room in the 261 apartments with sunlight and also with a view of the Charles River. Each living room opens onto a balcony that is separated from the room by a glass wall in an attempt to bring a bit of the outdoors into the daily lives of urban dwellers. The balconies are gaily painted in light colors.

The north side of 100 Memorial Drive is distinguished by a formal effect achieved by the rhythmic spacing of strip windows that band the wall in a pattern of excellent proportions. The approach to the main doorway is also on this side of the apartment house. It is protected by a long low canopy decorative in its bright color. The strip windows are placed along the corridors which occur on every third floor of the 12 stories in order to fit into a clever scheme of elevator service. To secure better ventilation and greater privacy for apartments on all floors, elevators stop only on floors which have corridors, and private staircases serve intervening floors. The service entrances and a semi-underground garage for 75 cars are also entered on this side of the building.

Although 100 Memorial Drive borders on a highway on one side and on an industrial area on the other, it is a satisfactory structure in appearance and, from the tenants' point of view, a satisfying apartment house in its interior arrangement.

From 1916 to 1950, the area under the large dome of the academic buildings served as general library, while smaller libraries on specialized subjects were scattered throughout the Institute. By the end of World War II, quarters became crowded in nearly all libraries and no additional space was available for developments supplementing literary resources. A grant from the Charles Hayden Foundation plus Institute funds made possible the construction of a new library

The Charles Hayden Memorial Library (above), *opened in 1950, is the main unit in the Institute's large library system. A music room, the Dard Hunter Paper Museum, an exhibition gallery, motion picture theater, and microreproduction laboratory also may be found here.*



Built in 1951, the Metals Processing Laboratory (right) *is occupied and used by the Department of Mechanical Engineering and the Department of Metallurgy. It houses complete facilities and equipment for metal cutting, grinding, welding, and processing of all kinds.*

building in 1950. The firm of Voorhees, Walker, Foley and Smith (Ralph T. Walker, '11, Benjamin L. Smith, '30) was chosen to design the Charles Hayden Memorial Library. Named for Charles Hayden (who was graduated in 1890), a generous benefactor, the library was opened for use in 1950.

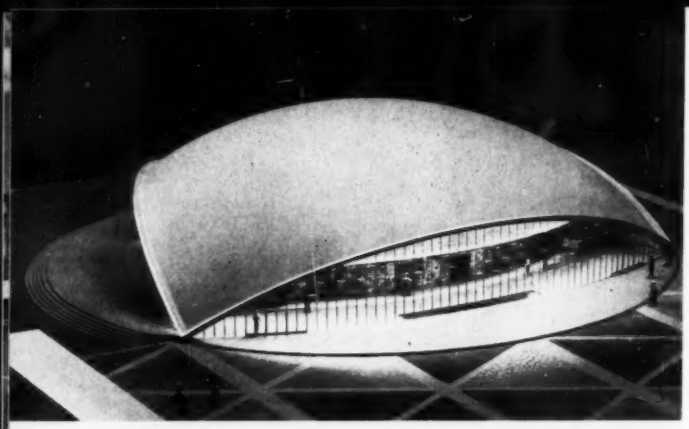
The Charles Hayden Memorial Library is joined to the east section of the 1916 academic group by a glassed-in corridor and is faced with light-colored limestone blocks. Designed in the form of a rectangle around a paved courtyard, three wings and part of the fourth are devoted to library use. An Exhibition Gallery, on the first floor, has direct access to Memorial Drive and is an important element in a library planned to keep step with present methods of instruction by so-called visual aids. The long rooms on the first and second floors facing the River are reading rooms which benefit from natural lighting during the day, since their south walls consist entirely of glass windows between essential structural strips. A soundproof music room, located on the first floor, is distinguished by the excellence of equipment for playing recorded music, and daily programs are scheduled in advance. In the basement, there is also a special projection room for showing film and lantern slides, and equipment for investigating methods of microreproduction and for duplicating library materials and records. The Dard Hunter Paper Museum, which probably has the most complete collection of hand-made paper and papermaking equipment in the United States, has quarters below the Exhibition Gallery. A well-stocked map room with a six-foot globe is located at the west end of the first floor. Processing departments and administrative offices are on the second floor.

As the central agency for administration and processing of all M.I.T. libraries, in no sense is Hayden Library a static organization. It is prepared to serve the complex demands of a large undergraduate college, as well as the specific requirements of advanced scholars in engineering and related fields. With modern equipment geared to progressive methods of teaching, it is far more than a mere repository of books; it is a vital force in the education of students.

The Metals Processing Laboratory was built in 1951 to bring together, under the direction of the Department of Mechanical Engineering and the Department of Metallurgy, the study of metallurgy and its application to basic processes of engineering. A gift of $1,000,000 from the Alfred P. Sloan Foundation made possible construction of the laboratory which was planned by Robert C. Dean, '26 – a member of the firm of Perry, Shaw and Hepburn, Kehoe and Dean. Parallel to Vassar Street, the building is connected with the Daniel Guggenheim Aeronautical Laboratory. With gray brick walls broken with regular rows of windows, its simple style is well adapted to the practical purpose of housing classrooms, a foundry, and other metallurgical equipment identical with that

The John Thompson Dorrance Laboratory of Biology and Food Technology is the latest of the Institute's educational buildings to be completed. It was fully described in the December, 1953, issue of The Review.

The Supersonic Wind Tunnel (left), *completed in 1948, the Hydrodynamics Laboratory and Towing Tank* (right), *completed in 1949, and the Alfred P. Sloan Building* (below), *acquired in 1950 for the School of Industrial Management and a Faculty Club, are important postwar additions to M.I.T.*



Model of the Kresge Auditorium which will seat 1,200 persons. The concrete shell has been poured and the unit is expected to be ready for use late this year.

found in manufacturing plants. A penthouse on the fifth floor, intended for student-faculty use, engenders informal discussions between the two groups.

One of the latest and one of the most striking buildings designed by Anderson and Beckwith is the John Thompson Dorrance Building for the Departments of Biology and of Food Technology. Occupied in 1952 the laboratory was named in honor of John Thompson Dorrance, '95, the founder and first president of Campbell Soup Company whose gift of $1,000,000 made construction possible. Although joined to the 1916 academic group by glassed-in corridors, the new building runs east-west and partly encloses the quadrangle formed by the east wing of the older buildings and Hayden Library. Where the prevailing height of buildings is four, the seven floors of the Dorrance Building give this unit a relatively skyscraper appearance. The sheer walls and slender width of the building express a concise use of materials, free of all influences of the past. The light and gleaming surfaces define the technological function of the laboratory without flamboyant announcement of its purpose. The east and west walls are of buff brick; the long south wall is divided into strips of windows in fine proportions. The windows on this south wall extend the full height of the offices and form a well-composed pattern.

The interior is an ideal setting for a modern laboratory with light colored walls and sunny rooms. In fact, bright surfaces and abundant daylight give this building a sense of light and air that, combined with excellent equipment, furnish an environment conforming to the best modern standards. Above the seventh floor an additional floor or penthouse, approximately half as wide as the lower floors, has special rooms for animals and also a small greenhouse.

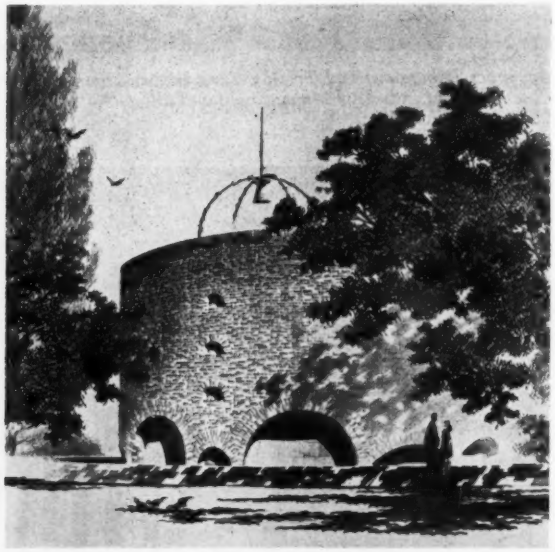
This brief description by no means concludes the list of buildings; there are many others. Some buildings – a few as far away as Nova Scotia – have been built, bought, or rented for the use of M.I.T., and others in the vicinity have been converted to Institute use. Several laboratories, such as the Supersonic Wind Tunnel (1948), the odd-shaped laboratory for the Van de Graaff high-voltage generator (1948), the Hydrodynamics Laboratory and Towing Tank (1949), have been built to contain specialized equipment that is the finest of its kind. Of course there are also the utility buildings essential to the functioning of the total complex. Land has been added to the original 50 acres on the Cambridge Embankment and frequent acquisitions by the Institute are steadily expanding its boundaries.

Of those added by purchase, mention should be made of the building at 50 Memorial Drive, formerly owned by Lever Brothers Company, which was bought with funds donated by the Alfred P. Sloan Foundation to house the School of Industrial Management. Designed over 10 years ago by the architect Donald Des Granges, '14, it conforms closely to the style of other M.I.T. academic buildings. The first floor has six interesting murals by Francis Scott Bradford depicting familiar scenes of Boston and vicinity. The remaining stories have been remodeled by William H. Brown, '33, Associate Professor of Architecture, as classrooms and offices, the third floor as a library, and the sixth or top floor as a faculty club.

But, the last chapter in architectural history has not yet been written. Designs have been prepared by Eero Saarinen and Associates for construction, with funds from the Kresge Foundation, of an auditorium and a small chapel west of Massachusetts Avenue. The plan of the auditorium now under construction is a brilliant departure from the traditional wedge-shaped, high-roofed hall; it is a low, triangular segment of a sphere caught into the ground by abutments at three points. It is a brilliant departure, also, from the classic use of a dome to cap a monumental building, for the roof which is actually one eighth of a sphere curves down on the three sides to form part of the walls. The interior of the auditorium will be divided into two levels, a hall seating 1,200 persons and a small theater on the lower level.

The little round brick chapel proposed by Saarinen, that will seem strange at first glance, is but an ancient form used by the Greeks in their temples, the Normans in their round churches in England, the

(*Concluded on page 376*)



Proposed for early construction is this design, by Saarinen, of a chapel to be built on the West Campus adjoining the Kresge Auditorium.

Is There A Limit to Human Life?

Intrigued through the Ages, Scientists and Philosophers Have Advanced Theories to Explain Longevity but Heredity Still Appears as Dominant Factor

By JAMES A. TOBEY

THE longest human life in history is supposed to have been that of an Englishman named Thomas Parr. This venerable gentleman is reputed to have been born in Shropshire in 1483 and to have died in London in 1635, at the fairly ripe old age of 152. Because of the notoriety connected with this alleged great age, he was buried in the south transept of Westminster Abbey, where the inscription on his tomb states that he lived in "ye reignes" of 10 princes, from Edward IV to Charles I.

According to tradition, Thomas Parr spent the first 80 years of his long life working as a bachelor farmer. Then he married and sired two children, both of whom died in infancy. At the tender age of 105 he was charged with having caused the birth of an illegitimate child and was sentenced to do penance by standing in the church door in a white sheet. His wife died when he was a mere 110, but he remarried at 112, and at 130 Mr. Parr was busily engaged in threshing corn.

In 1635 the fame of this antique specimen of humanity reached Thomas Howard, Earl of Arundel, who whisked him off to London, presented him to King Charles, and otherwise made much of him. The fast life of the metropolis, or as the contemporary accounts put it, "the change of air and diet," proved too much for the old man, and he succumbed in November of 1635. An autopsy was performed on the body by Dr. William Harvey, celebrated as the discoverer of the circulation of the blood, who reported that the physical condition of this famous English centenarian was excellent.

The advanced age of "Olde" Parr would, if true, be of tremendous interest and significance to all concerned with human longevity, but unfortunately it is not true. No one disputed this unusual age, however, until 1873 when a skeptical librarian of the House of Lords, William J. Thoms, decided to investigate this case and numerous other alleged instances of extreme old age. A good basis for his study was a report published in 1800 by James Easton listing no less than 1,712 "true" centenarians who had flourished from 66 A.D. to 1799. Included, of course, was Olde Parr and another man named Henry Jenkins, who was declared to have been even older, a modest 169. Also in the record was a Countess of Desmond at 140.

After an exhaustive examination of 22 cases of such human sempiternity, the doubting Mr. Thoms reached the apt conclusion that the evidence justified none of them. He demonstrated, for example, that the lives of two different countesses of Desmond had been added together to produce the age of 140, and that neither of them had lived much beyond 70 years. With respect to Thomas Parr it was shown rather conclusively that at least 50 years had been erroneously, or even fraudulently, added to his actual age and that he could not have been over 100 years old at the time of his death.

Despite this masterful job of debunking, one will still see occasional references to Olde Parr as the oldest man in the world. The lie lingers on, but the correction is forgotten. There is even a short article on Thomas Parr in the 14th edition of the *Encyclopaedia Britannica*, but no mention of the work of Mr. Thoms of the House of Lords.

A few years after this nice bit of exposure, another author who was familiar with it, John B. Bailey, issued a book entitled *Modern Methuselahs** in which he described numerous real and near centenarians, but he was able to find only about a dozen individuals who were undeniably in this hoary category. In another competent survey of centenarians, made in 1899 by a British actuary, T. E. Young, only 22 authentic instances of persons aged 100 years or more were cited, although a second edition of this work, issued in 1905, added another eight to the original list. The longest verifiable age mentioned by Mr. Young was one of 111 years, and in the 50 years since this report, no one has been able to offer acceptable proof of any human life longer than this. There have been plenty of claims, but no proof. Thus, about the time Young's second edition came out, a Russian newspaper blandly announced the death of a woman named Therese Abalva at the somewhat advanced age of 180, but offered no evidence to substantiate this extravagant and incredible statement.

The only instance of unique senescence which offers even a scintilla of reliability is that of a Dane named Christen Jacobsen Dragenberg, who was reported as living to the age of 146. A reputable statistician who wrote up this case in an actuarial journal was convinced that it was true, but most biologists are skeptical. This Dragenberg was said to have been born in 1626, to have gone to sea at the age of 13, to have served three kings in wars against Sweden, to have been captured by Algerian pirates at the age of 70, and to have been held in captivity for 19 years. Like

* London: Chapman and Hall, Ltd., 1888.

Olde Parr, he is asserted to have had one of those colorful marital careers, with betrothal at the age of 111. He outlived his young bride of 60 and died in the year 1772.

Even if this particular case is genuine, which is doubtful, many other instances of reputed longevity beyond the age of 110 have been definitely shown to be mistakes or frauds. The flamboyant Phineas T. Barnum began his colorful career as a showman in 1835 by exhibiting an ancient-appearing negress, one Joyce Heth, who was asserted to be 160 years old, and more than that, to have been the nurse of George Washington. When she died in 1836, Joyce was proven to be no more than 70 years of age, and to have been born when our first president was 34 years old. Nothing daunted, Mr. Barnum turned his attention to dwarfs, opera singers, and circuses, and later wrote a book on *Humbugs I Have Known*† — a subject upon which he could write with authority.

A few years ago this country was favored with a visit from a venerable Turk, one Zaro Aga, who claimed that he was 156 years of age and the oldest man in the world. After getting considerable attention from the gullible public, he was finally induced to submit to a medical examination by several distinguished physicians, who reported that he was undoubtedly somewhere between 90 and 100 years of age. Then there was the Kentuckian named John Shell who achieved some notoriety several years ago by stating that he was 131. The late Dr. Raymond Pearl, an eminent biometrician, looked into the case and decided that Mr. Shell might be in the vicinity of 100, but certainly no more than that.

From the Balkans, where birth certificates always have been unknown and memories are unreliable, have come many tall tales of extreme old ages, usually attributed to the lifelong consumption of black bread and fermented milk. One example is Marie Priou who died in 1838 at the reputed age of 158. Her case and many others of like duration, all hearsay, were faithfully reported by Professor Élie Metchinikoff, a famous bacteriologist, who got out a book on the Prolongation of Life‡ early in the present century. In this weighty tome the professor declared that modern man ought to live to be at least 120.

Although a few enthusiastic scientists have predicted that man can, and some day will, live to be 150, there is no reliable evidence that anyone ever has done so, and it seems doubtful if anyone ever will do so. But who can tell? The consensus of scientific opinion is that there is a definite limit to human life, a limit now and perhaps forever in the vicinity of 100 years. On very rare occasions individuals exceed this limit by a few years, but no one has been proven to have lived longer than 111 years. Human life, is, in fact, like a clock; it is set for a definite time. Sometimes, unfortunately, the clock stops before our time is reached.

We do not know accurately how many real centenarians are now living in the United States, but a good guess might be somewhat over 1,000. To be sure, you can find in the federal census reports of about 4,000 persons who are alleged to be 100 or more, but all authorities regard these figures as utterly unreliable, since they are compiled from individual statements. About two thirds of these persons claiming advanced ages are Negroes, who comprise only about 10 per cent of the population. A century ago birth records were not kept with any degree of accuracy in most parts of the country, with the exception of the New England States and New York, and age is one of the subjects on which most memories seem woefully defective.

During a career of more than a third of a century in public health work the author has encountered only one genuine centenarian, and even he was a few months short of the mark. This gentleman was Dr. Stephen Smith, who was born in Onondaga County, New York, in 1823. He was one of the founders of the American Public Health Association in 1872, and at the 50th anniversary banquet of the Association in New York City in 1922 Dr. Smith walked briskly in, stood up for 20 minutes or so and read in a clear voice a speech which he had written. He was then 99 plus, and a few months later he died just under 100 years of age, but more than that if you include the period of gestation. The painter, Titian, was also active up to his 99th year and might have lived longer if he had not been cut down by the plague in 1576.

The fact that the ultimate length of human life seems to be biologically fixed does not mean, of course, that individual lives cannot be extended so that more of them may attain the biological limit. In 1900 the average span of life in the United States, or the expectancy of life at birth, was only a little over 47 years; in 1930 this figure had risen to about 60 years; in 1940, to about 63 years; and in 1949, to 67.6 years for the entire population; and to 71.5 years for white females. The latest data, for 1950, reveal a new high of 68.4 years for all the people. Since women live longer than men, on the average, the expectation of life at birth for white females is 72.4 years, while for white men it is 66.6 years. The nonwhite figures are seven or eight years lower.

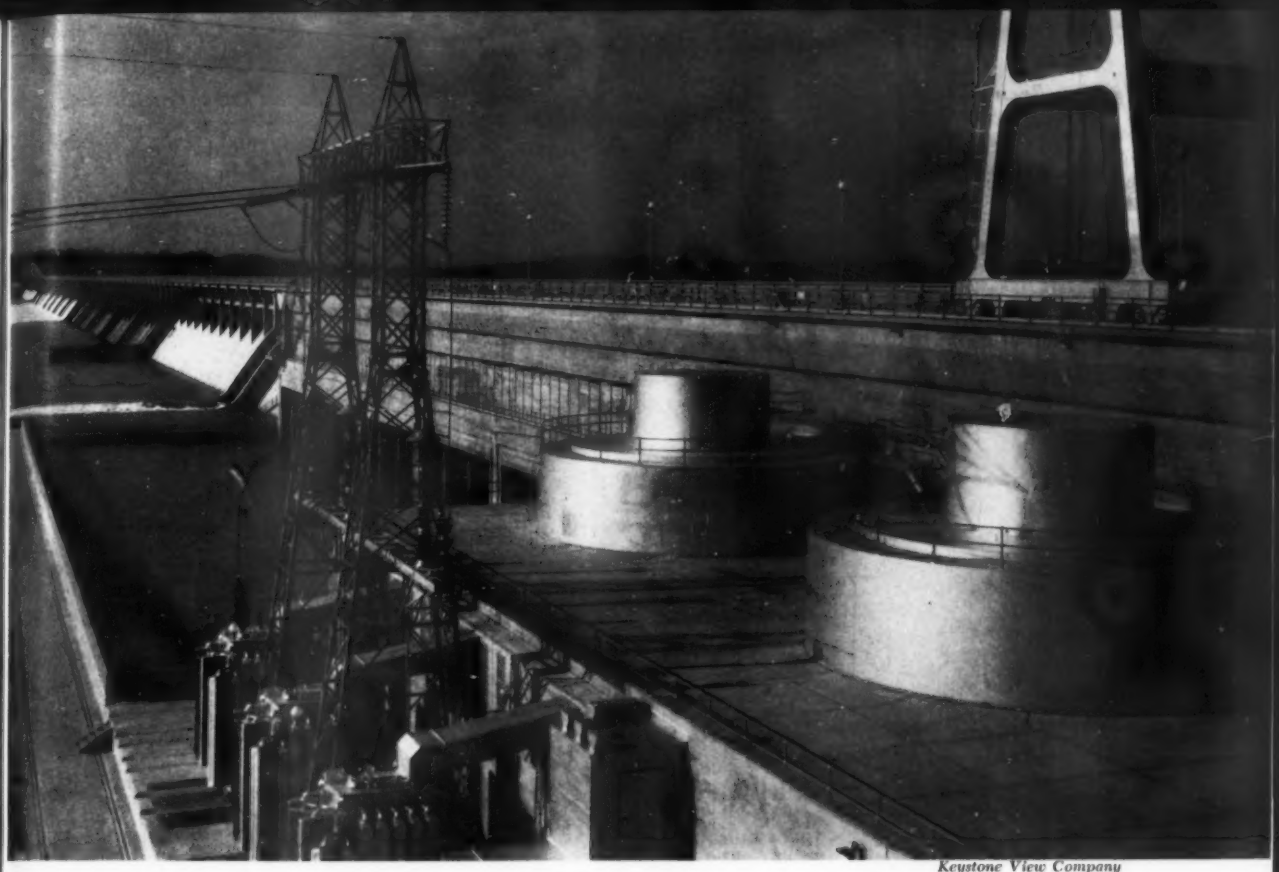
When we speak of the "average" length of life, we are of course using figures computed from the deaths at all ages, in infancy, childhood, and adolescence as well as in middle and old age. The most dangerous period of human life is its first year, but this first year is much less hazardous today in the United States than it was a generation, or 50 years, ago. In 1933, the first year for which we have complete statistics on infant mortality, there were 58.1 deaths of infants under one year of age per 1,000 live births, whereas in 1950 the rate was 29.1, or almost exactly one half that of 1933. There have been comparable reductions in maternal mortality, in deaths due to childhood diseases, and in tuberculosis — the mortality of which has declined about 90 per cent since 1900. No longer does consumption deserve the epithet of "captain of the men of death," as it did at the turn of the century. Its place has been taken today by diseases of the heart, the afflictions which befall an older population.

The people of the United States are growing up. Whether they have matured socially, culturally, in-

(*Continued on page 376*)

† New York: Carleton, 1865.

‡ New York: G. P. Putnam's Sons, 1908. [Translated by P. C. Mitchell.]



Keystone View Company

ELECTRICAL ENGINEERING IN A NEW KIND OF UNIVERSITY

By ARNOLD TUSTIN

ENDURING memorials to the life and work of Edwin Sibley Webster already exist. One such memorial is the great industrial organization that he built; another is the work of this Institute he did so much to support and guide; and another is the progress his interests stimulated in many branches of technology.

Edwin Sibley Webster was one of the earliest students in the Department of Electrical Engineering at M.I.T. The Webster Chair in this Department will specially and fittingly recall the remarkable vision with which he foresaw the significance of technical education, as well as his many contributions to fostering its development.

The immediate purpose to which the benefaction is being directed is the building up of activity in the fields of energy conversion and electrical machinery. The electrical power industry is doubling in size each 10 to 12 years. Advances in its techniques are as noteworthy as those in size. Only 10 years ago the high-speed turbo alternator was limited to outputs per unit of 70,000 kilowatts. Today units of 200,000 kilowatts exist, and units of 300,000 kilowatts are contemplated. The breaking capacity of power circuit breakers has been increased in less than 10 years from 5,000,000 to 25,000,000 kilovolt-amperes, and much higher values must be achieved to meet the needs of the power services of the future.

Despite this major growth and the range of problems that it is making acute, the power branch of electrical engineering has been steadily becoming neglected by the universities and teaching institutions in favor of electronics, communications, control systems, and the like. This is the case not only in the United States but in Britain and elsewhere. But due to the forward-looking habit of M.I.T. and in particular to the vision of Gordon S. Brown, '31, Head of the Department of Electrical Engineering, steps are being taken to rectify this deficiency in good time, and this Webster Chair will make a most timely and substantial contribution to this project.

During my tenure of the chair, it is my hope to see at least the beginnings of a new spate of basic research and active, high-level, postgraduate teaching in this field. Also I hope to see the same sort of impact made on the energy-handling branches of electrical engineering as M.I.T. has lately made in control, in communications, and in many other fields.

Technical Education

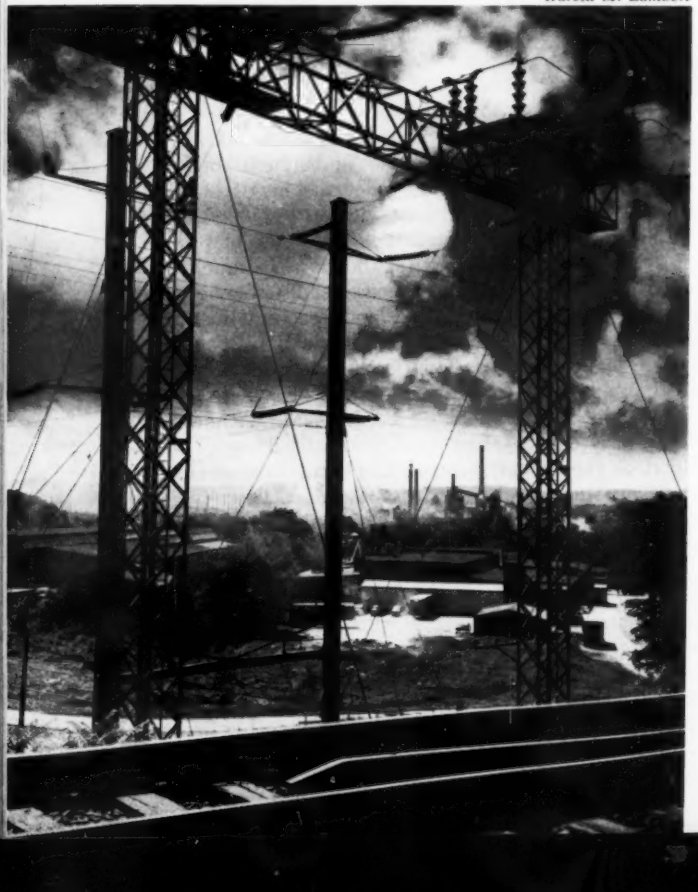
On the occasion when we recall in particular Edwin Sibley Webster's work in fostering technical education, it seems appropriate that this inaugural address should have technical education as its topic. Today, applied science has grown out of its baby clothes, and might be likened to a vigorous if somewhat slapdash youth, who has still to grow to maturity, to integration, and to responsibility.

Can we too, as Mr. Webster did earlier, also look ahead and discern the needs of the future from this stage where both applied science and technical education have become so highly developed?

I believe we can, and in the title for this address, I have adapted a phrase in which James R. Killian, Jr., '26, President of M.I.T., aptly crystallized certain aspects of the needs in technical education in the near future: the phrase "a new kind of university." I believe that the conception is taking shape that a "university for the modern man" can and should be built around the teaching of applied science as its core, and that it is possible, and indeed likely, that M.I.T. may become the prototype of this new kind of university. I propose therefore to take this phrase of Dr. Killian as a suggestive specification, to consider what might be the objectives and purposes of this new kind of university built around the applied sciences, and to try to sketch, in the true spirit of the engineer, at least some of the main lines of a design to meet the specification.

Before I attempt to do this I think that I should remind you that what M.I.T. does in its next stage of advance is important, not only in its direct and immediate outcome, but in the extent to which, all over the world, its activities are observed, discussed, and imitated in various ways and degrees. The status of M.I.T. in technical education is unique.

One true social need is certainly that many more men knowing much more about science must be provided.
Harold M. Lambert



The Present Status of M.I.T.

Perhaps I may illustrate this in passing – although this means departing for a few moments from my main theme – by telling you what happened in my home University of Birmingham, when Professor Brown descended on us out of the blue, or more literally out of the grey sky of a wet English summer, and conveyed to me your invitation to occupy this chair.

I need not say how deeply I personally appreciated the honor of being so invited; but, in so relatively modest an establishment as ours, it is no small matter to cast a year's work onto the shoulders of one's good colleagues. Therefore, I revealed your invitation first at our departmental staff meeting. The response was voiced by one of my younger colleagues in the words "Professor, we'll pass the hat round for your fare." There was, it is true, a possible ambiguity in this remark, but I took it in the spirit I knew it was meant, and broached the matter at Faculty Meeting.

It would have been pleasing to you to have seen how immediate and unanimous was the response of the Vice-Chancellor, the Dean, and the Faculty members, to the effect that means must be found for this invitation to be accepted. It was instantly recognized that such an invitation from M.I.T. was an honor to our university and that M.I.T., above all other places, can offer experience, stimulus, and a foretaste of the future that are unique.

British Controversy on Engineering Education

During the last few years in particular, M.I.T. has been a focus of attention in Great Britain because a wordy battle has been raging over whether or not we are to have a British Institute of Technology. It is one more tribute to the status of the Massachusetts Institute that "A British Institute of Technology" is, as often as not, colloquially rendered with disregard for geography as "A British M.I.T."

You probably all know that a final decision has been staved off by the compromise, as a first step, of doubling the size of the applied science departments at Imperial College, and increasing the number of postgraduate students in certain other universities.

The controversy is not closed, and I am sure that when I return to England I shall be assailed by demands for the inside story about M.I.T. The question that I shall certainly be asked is "What sort of men does M.I.T. turn out?"

It is, of course, in relation to the breadth and completeness of the development of the students that battle has been joined. There is certainly a need for more and better electrical engineers, metallurgists, and so on, but no one – here or anywhere else – suggests that an intensive training in technology alone is likely to turn out men who are sensitive, mature, integrated, and socially responsible, and this we also want.

The question much debated in Britain is whether full development of human potentialities could adequately be fostered in institutes of the M.I.T. type, or whether it emerges only when the students of arts mingle with students of engineering on the same campus, which is supposed to generate what is referred to as a "university atmosphere." Personally I do not think the type of institution is the decisive factor. My own observation is that, in general, the British university is not at present giving to students in applied science an education adequate for a modern man. Here at M.I.T. the engineering student has, interlarded between his mathematics and his laboratory work, an impressive sequence of lectures on topics from Plato to J. M. Keynes. Does such factual instruction have much formative effect? It may, but it very well may not. In both environments some catalyst is needed to evoke the right type of spiritual ferment.

Those who plan courses of instruction for a technical institute have at least one advantage. The requirements for explicit provision of means for broader education present themselves obviously and urgently, and cannot be left to uncertain contagion from the students from departments of Greek or theology.

In our design for a university for a modern man we must provide the means to secure the ends we desire. But what are the needs of society with respect to the education of this increasing proportion of our best-born youth who will find their life's work in the development laboratory, the design office, and the plant? The need is that they should contribute to the maximum to a better society.

One true social need is certainly that many more men knowing much more science must be provided. Man is changing his way of life. Vast new productive possibilities are being opened up by the organization of co-operative work, by the creation of new complex tools, and by ever-deepening understanding of the physical world. For this, armies of men skilled in various ways in applied science, will be required.

Here immediately arises a basic social problem, for only a small proportion of men are born with mental aptitudes such that they can become skilled in these complex arts, at the advanced level now required, as a result of a period of training that is economically and psychologically practicable. To provide education that is adequate for social needs – both with respect to the high technical level of training as well as with regard to breadth of knowledge and interests, and personal and emotional development – is to meet a very onerous specification. Our dilemma is a very real one. We may too lightly overlook the possibility that there may be no possible solution, at least, not without making changes or compromises of a very radical kind.

All but the most highly gifted students already stagger under the burden of intensive acquisition, in a very limited time, of loads of knowledge and skills. Like burdened camels they thread the needle's eye of successive examination. The kind of life that such academic discipline imposes on the less able students at some stage ceases to be compatible with either breadth or spontaneity. We may sometimes get

Keystone View Company

To provide education that is adequate for social needs – both with respect to high technical level of training as well as with regard to breadth of knowledge and interests, and personal and emotional development – is to meet a very onerous specification.

a quart out of a pint pot, but seldom two quarts. I do not doubt that methods of selection and methods of instruction will both improve, but the demands also grow steeply. The steam engine gives way to the airplane and the slide rule to the digital computer.

It looks as though the exploitation of science may encounter a limiting rate set by the distribution of intelligence quotients in our populations. But even if this is the case we must not so overforce the production of scientists-at-all-costs that we turn out men who are morons in every other respect. I suggest that we can relieve this situation, and still give proper weight in our new university to broad development, as well as to technical *expertise*, in at least three ways.

Firstly, let us accept the fact that technical training is spread – and must be spread – over vastly more of a man's life than his years at the university; we must provide more adequately for this continued education. We must recognize, as major obligations of our teaching institutions, the writing of books, support of the professional institutions, and the organization of advanced specialized courses, near places where men work. We must encourage and make possible the habit of return to the institute for supplementary specialized work at intervals throughout professional life.

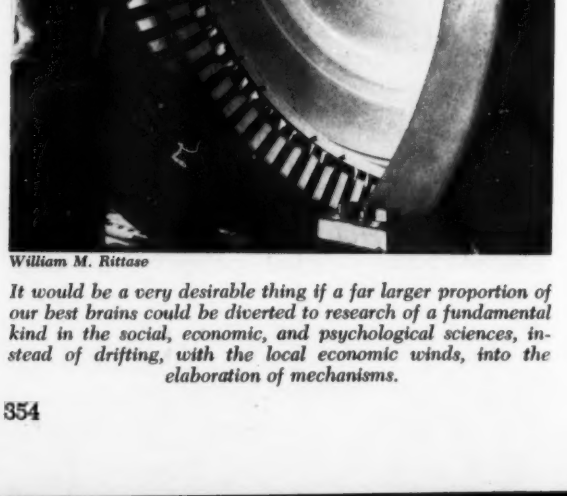
Secondly, where student caliber will not allow more, let us be content to build, on a broad base of general scientific training, only a narrow pinnacle of specialization, to be added to and broadened later.

Thirdly, let us give more attention to the proper classification of entrants to training, both in respect

to ability and in respect to the general type of work for which they are being trained. The teacher's present nightmare is to provide a curriculum that is optimum for all students in a class that ranges from a brilliant few to a mediocre tail. Reasonable homogeneity of aptitude is required, and this can never be attained when all colleges are pulling equally hard to get as many of the best students as possible. Some co-operation in this respect would pay dividends. Similarly an optimum curriculum can scarcely be devised if we lump together the men who are to become the broad type of engineer-manager and those fitted to be the back-room analyst. No one expects or desires a student to plan his whole career during his university life, but there is a logical case for curricula being planned to provide training of a stated type.

The Scope and Content Required in a Program for Broader Education

With these few suggestions I shall, for the moment, leave the technical curriculum, and turn to the matter of controversy. What are the needs of society in respect of requiring, in its applied scientists, sensitivity, maturity, integration, responsibility, a sense of proportion, a sense of humor, and in fact all those aspects that make the man as distinct from the calculating machine? How shall these needs be met in our university for the modern man?



William M. Rittase

It would be a very desirable thing if a far larger proportion of our best brains could be diverted to research of a fundamental kind in the social, economic, and psychological sciences, instead of drifting, with the local economic winds, into the elaboration of mechanisms.

If this were a matter of imparting some items of knowledge, the problem would be an easy one, but this is not the main problem. Some specific knowledge certainly is indispensable to our modern man. We would expect him to have a mastery of at least his own language, to have some broad acquaintance with the main lines of human history, and with the status and limitations of current beliefs about man's place in the universe and his evolutionary origins. We would expect him to have some knowledge of the working of our economic systems, and of their relationship to recent economic history and current controversy. I do not see that there is much else that is indispensable. To ensure basic factual knowledge of this sort is not difficult. Obviously, however, such an approach could well miss the main issue. We are concerned with what the man is, rather than what he knows. We are concerned essentially not so much with the operations of the intellect as with essential vital processes and with the world of feeling, purpose, desire and aspiration, and the patterning of these in personality.

Of course, the need to provide some instruction in English, and in the social sciences does indeed open an immensely valuable channel for stimulus of this vital growth. Professional training can also be a channel equally significant in these broader aspects. What seems to be required is a vital fusion of both.

As it now exists, M.I.T. is a unique experimental ground for discovering how that catalyst, or leaven, may be thrown in to transmute a school of technology into the university of the modern man. The policy of M.I.T., in recent years, of extending and broadening the general aspects of education is, in my view, a policy of wisdom and foresight. These aspects are contributed mainly through the School of Humanities and Social Studies. I have already sensed the excellence of the work they are doing, and I would like to offer for your consideration some thoughts on the way in which the work of departments of general education, in our new kind of university, might be more completely integrated with the work of the technological departments, in order that the combination be related more meaningfully to the world of purposes and values.

One door to this seems to me to be wide open. It is the concept itself of the aim and purpose of applied science as human welfare. Let us wholly accept as the master purpose, aim, and principle of design of our new institute, not the mere feeding of research results to a blind economic machine, but the global problem of applying all our knowledge and understanding to the betterment of the human future. This must be understood as including and combining the study of means and ends; it must find the complement of the physical sciences in economics, in the social sciences, in a moral philosophy, and above all in a sharpened sensitivity and awareness of our values.

In implementing, guiding, and inspiring the global research activity of such an institute into a relationship of science to human welfare, the departments of social science and economics would clearly have to play a major role. For the present and for the indefinite future the real problems have to do with ideo-

(Continued on page 362)

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Alumni Day, 1954

This year, Alumni Day, which falls on Monday, June 14, will feature a discussion on "The Next 10 Years" — a forecast of the new trends, achievements, and problems that will confront the engineer and the executive during the next decade. Karl T. Compton, chairman of the M.I.T. Corporation, will be moderator of a panel of speakers consisting of: Vannevar Bush, '16, President of the Carnegie Institution of Washington; E. P. Brooks, '17, Dean of the M.I.T. School of Industrial Management; and Edward L. Cochrane, '20, Vice-president for Industrial and Governmental Relations at the Institute.

In addition to this symposium, Technology Alumni returning to M.I.T. will have opportunity to visit their departments and inspect Technology buildings, of which the Dorrance Laboratory and the new Kresge Auditorium are the latest additions to Technology structures.

In accordance with the custom of the past few years, James R. Killian, Jr., '26, President, will present his "state of the Institute" address at the luncheon in the Great Court at noon. Dr. and Mrs. Killian will again hold Open House in the afternoon.

In the evening, the annual Stein-on-the-Table Banquet will be held at the Hotel Statler, and William B. Given, Jr., '08, chairman of the Board, American Brake Shoe Company, will be the principal speaker. Mrs. Karl T. Compton will be the speaker at the Ladies' Banquet.

At the Institute's 88th graduation exercises on June 11, the commencement speaker will be Clarence B. Randall, chairman of the Board of Inland Steel Company of Chicago and chairman of the U.S. Commission on Foreign Economic Policy.

Graduate Students As Alumni

At the present time, about one fourth of all M.I.T. students are enrolled in the Institute's Graduate School, and, of this group, approximately three quarters have received their undergraduate training at some other educational institution. Those holding advanced degrees often have loyalties to more than one university, and the rapid rise in graduate study in the United States within the past decade or two has accentuated the need to give more thoughtful consideration to the alumni loyalties and interests of those who study and further their education at several different colleges and universities.

This problem is not unique with M.I.T., but perhaps the problem is most clearly perceived here because the Institute awards nearly one tenth of all the advanced degrees in science and engineering which are granted in the United States each year. Accordingly, in May, 1952, the Executive Committee of the Alumni Association appointed Hugh S. Ferguson, '23, chairman of a committee whose other members were Leicester F. Hamilton, '14, Professor of Analytical Chemistry, and Harl P. Aldrich, Jr., '47, Assistant Professor of Soil Mechanics. This committee was charged with responsibility for studying the status of the Institute's graduate students who had received their undergraduate training elsewhere,* and to recommend ways of providing more effective participation in matters relating to M.I.T. and the Alumni Association. Members of this committee, together with six guests, summarized the results of their studies at a meeting on February 16, 1954. The committee also presented its recommendations to the Alumni Council at its meeting on March 1, at which time its report was accepted with appreciation.

The committee noted with pleasure that the past year had seen the establishment of a Graduate Student Council (for graduate students currently registered at M.I.T.) with its own campus publication entitled *The Graduate Student News*. Thus, a mechanism has already been created which should be helpful in fostering class spirit and loyalty to M.I.T. while graduate students are still pursuing their studies at the Institute. A step in fostering M.I.T. loyalty among graduate students who took their undergraduate work elsewhere was already taken last May, when the letter from the president of the graduating senior class had its counterpart in one written for graduate degree candidates by the president of the Graduate Student Council, Nolan T. Jones, a candidate for the S.M. degree in 1954.

Believing that graduate students prefer to have their alumni affiliation with the Institute identified as of the year in which they receive their first (advanced) degree from M.I.T., the committee recommends that:

1. Each spring, beginning in 1954, the Graduate Student Council be asked to choose Class Officers from among the group who will receive their first (graduate) degrees from M.I.T. the following June, said "Graduate Class Officers" to be the counterparts of "Senior Class Officers" elected at the same time by the senior class. As used here the term "Graduate Class Officers" refers to those graduate students of M.I.T. who do not already have class affiliation or alumni status as a result of previous study, at the undergraduate level, at the Institute.

2. Graduate Class Officers fulfill for their group essentially the same functions now prescribed for "Senior Class Officers" as set forth in the Association's *Class Officers Manual*, and that the terms of office of the Graduate Class Officers also be for five years.

3. Particular care be exercised, especially in 1954, to urge election of a secretary and one or more assistant

* No succinct and satisfactory term has yet been found to designate those students achieving alumni status through study only in the Institute's Graduate School. The terms "Graduate Student" and "Graduate Class Officer" are used here in the sense of designating only those M.I.T. graduate students whose undergraduate work was done at an educational institution other than M.I.T.

secretaries from among those graduate students who may be especially interested and competent to prepare monthly notes for inclusion in The Technology Review as a section of the 1954 Class Notes. (It is contemplated that the 1954 Class Notes will carry at its end the names and addresses of the secretaries of the Senior Class as well as of the Graduate Class.)

4. The Graduate Student Council be asked to suggest, for appointment by the Alumni Fund Board, the name of a man to serve as counterpart of the 1954 Senior Class Agent, as Class Agent for those receiving their first (advanced) degree in 1954.

5. Beginning next autumn, the Executive Committee of the Alumni Association of M.I.T. invite a representative of the 1954 Graduate Class Officers to be a guest at Alumni Council meetings. (It is contemplated that a constitutional change may be made to provide for two regular representatives of the Class of 1954 and subsequent classes, one being from the "Senior" group and the other from the "Graduate" group.)

6. The Executive Committee of the Association continue to invite a representative of the Graduate Student Council as a guest at Alumni Council meetings.

The committee was also of the opinion that an attempt should be made to establish similar class organizations for those who have previously received only graduate degrees from M.I.T. Students who become M.I.T. Alumni through attendance only in the Graduate School should receive all general alumni mailing and special mailings, such as:

1. A bulletin, prepared annually by members of the Faculty or Administration, reporting recent developments in the Graduate School. Such a bulletin would replace the Class President's Letter which, henceforth, will not be sent to those students who have been enrolled only in the Graduate School of M.I.T.

2. Letters soliciting contributions to the Alumni Fund prepared by a Committee of Graduate Class Agents appointed by the Alumni Fund Board.

Richard W. Long: 1888-1953

TYPICAL of the benefits which may be shared by industry and by education was the talent of Richard W. Long. Upon his death on November 13, 1953, tribute was paid by the Institute and by the New England Mutual Life Insurance Company, where Mr. Long was employed as engrosser in the Policy Department.

Since 1912 Mr. Long has inscribed 32,933 degrees for M.I.T. The names of Alumni engraved in his beautiful handwriting exemplify a handcraft of a high degree of skill, not incongruous with the proficiency attained in the mechanical arts and technology of those whose names have been written.

Mr. Long was born in Fort Jones, Calif., of American Indian parents. His mother was a member of the Shasta Tribe, and his father a member of the Hoopa Tribe. He attended the Salem, Ore., Indian Training School, where, in addition to the usual subjects, he studied the trade of printing. He also attended Capital Business College in Salem, and Haskell Institute in Lawrence, Kansas. He was completing a year's study of handwriting at Zanerian College in Columbus, Ohio, when he had an opportunity to come to Boston with the New England Mutual, and it was soon after that that the Institute acquired the services of this excellent penman.

A resident of Wakefield, Mass., Mr. Long was a prominent Mason and held many offices. At the time of his death he was vice-president of the Masonic Secretaries Association of Massachusetts. He is survived by three sons, Richard W., Jr., Gardner R., and Merritt D. Through the assistance and co-operation of Mr. Long's sons the Institute will be able to continue to provide, for its graduates, degrees representative of the high standards of workmanship initiated several decades ago by Mr. Long.

The inaugural lecture of the Edwin Sibley Webster Professorship was delivered at Walker Memorial, M.I.T., on February 11, 1954, by Professor Arnold Tustin (center), of the University of Birmingham, England. Professor Tustin, who holds the Webster Chair as Visiting Professor for 1953–1954, is shown here on the occasion of the lecture with Gordon S. Brown, '31 (left), Head of the M.I.T. Department of Electrical Engineering, and James R. Killian, Jr., '26, President of the Institute. The Review is pleased to present the text of Professor Tustin's lecture, "Electrical Engineering in a New Kind of University," in this issue, page 351.

M.I.T. Photo

Harold K. Barrows: 1873-1954

SORROWFULLY The Review records the death, at his Winchester home on March 15, of Harold K. Barrows, '95, Professor of Hydraulic Engineering, Emeritus, a nationally recognized authority on hydraulic engineering who served for 33 years on the faculty of the Department of Civil and Sanitary Engineering at the Institute. He was 80 years old.

Professor Barrows was born in Melrose, and following his graduation from the Institute was associated with the Newton city engineer, the Metropolitan Water Board, and the faculty of the University of Vermont before returning to M.I.T. in 1910 as associate professor of hydraulic engineering. Professor Barrows was named professor in 1921 and, following his retirement in 1940 was an honorary lecturer for three years.

A specialist in hydraulic water power, water supply work, and flood control, he was employed as a consultant by many state, public utility, and power commissions. He headed a flood control study in New England and New York, acted as advisory engineer for the New England District of the Reconstruction Corporation, and was regional consultant for the National Resources Commission. Professor Barrows was also the author of numerous books and papers in the field of hydraulics.

A past president of the Boston Society of Civil Engineers, he was a member of the American Institute of Consulting Engineers and the American Society of Civil Engineers, and a fellow of the American Academy of Arts and Sciences. Professor Barrows is survived by his son, Kilbrith Jordan.

National Safety and the Universities

IN an address at the luncheon of the 33d annual Massachusetts Safety Council Conference at Boston's Hotel Statler on March 22, James R. Killian, Jr., '26, President of M.I.T., spoke on "Universities Serve the Nation's Safety." Dealing with three comprehensive safety goals of the universities, Dr. Killian discussed physical and political safety against external attack, the economic safety of New England, and stressed the critical importance of intellectual and moral safety in our educational institutions. Excerpts from Dr. Killian's address are given below. On the topic of Military Defense, President Killian said, in part:

> The first of these goals has to do with our military defense. This vast program impinges upon every aspect of our national life, including our universities, and particularly our universities here in New England. At the present time, institutions of Greater Boston have mobilized hundreds of scientists and other scholars who are working unselfishly, quietly, and patriotically to give the nation stronger defenses at lower cost. In fact this area has become one of the nation's largest and most important centers for defense research. For example, New England educational institutions are responsible for nearly one third of all of the research undertaken by colleges and universities for the military services. The Air Force recently announced that it had awarded research contracts totaling some $82,000,000 in New England and that this area "seems to have become our most important development area. . . ."
>
> A large and urgent defense project now operated by M.I.T., the Lincoln Laboratory, is a dramatic example of how educational institutions can provide emergency service to the nation. It is also in the fullest sense of the word a major effort in the field of safety engineering, for the objective of the Laboratory is to assist in providing the nation with a more effective defense.
>
> The second safety function of our universities is to strengthen our community and regional economy. I submit that in New England, in Massachusetts, and in Metropolitan Boston, our universities are important partners of management and labor in maintaining a vigorous economy. Out of the universities are coming directly new products, new industries, new wealth. . . .
>
> Military strength and foreign alliances are not enough to guarantee the safety of the nation. The stamping out of subversion is not enough. These essential safety measures are but incidental to our central task of maintaining our national integrity, of protecting the coalition of ideas, concepts, and ideals which give our society its meaning, unity, and stability. Progress, peaceful adjustment to change, an acceptance of dissent, a repugnance for regimentation and enforced conformity, a belief in the supreme importance of the free individual – these have been the shared convictions which have held our nation together.
>
> These shared convictions are the underpinning of our national loyalty. This loyalty comes not from fear, compulsion, or decree. It springs naturally from a sense of belonging, from a confidence and faith in one's country and one's self from a love of place, from the proud identification of one's self with a great heritage and a noble cause.
>
> Our schools have a crucial responsibility to safeguard this aspect of our national integrity. They must exemplify our national ideals of equality, social justice, freedom, and individual dignity. They must cultivate and refine the moral idealism which is the cement of our society.
>
> It *is* the responsibility of the university and the scholar to combat and denounce unfair and ignorant criticism, to resist the pressures toward stifling conformity, and to make clear the policies and goals of our universities. This I do with relish and happily with freedom. It is our still greater responsibility to protect and maintain inviolate the free and objective pursuit of truth which is the mission of the university. This mission is so deeply interwoven with our national safety, stability, and self-respect, that it must be defended against every encroachment.
>
> Far more is involved here than protecting "academic freedom." Academic freedom somehow has come to connote academic privilege, which it is not. What is involved is the formulation, explanation, and protection of those tested means by which a free society most effectively preserves its past, creates its future, and prepares its young people to be its citizens, its experts, and its leaders.
>
> We must make it clear that a voluntary association of free scholars pursuing truth freely wherever and however it may be found is the tested way of accomplishing this mission for our society.
>
> It is the responsibility of our strong and stable institutions to demonstrate that this is true and to resist with courage and determination any distortion of their tested procedures.
>
> It is the responsibility of our society to insist that our schools continue to be the sanctuary of the mind that is joyfully free so that they can continue to teach and perpetuate the freedom which is our nation's "supreme treasure." It is in the light of this responsibility that we can think of these institutions as one of the agencies most essential to the safety of our nation, our democracy, and our individual dignity.

Pierre S. du Pont: 1870-1954

As this issue of The Review goes to press, it is our sad duty to record the death in Wilmington, Del., on April 5, of Pierre S. du Pont, '90, who served for 35 years as a Life Member of the M.I.T. Corporation. He had been an emeritus member since 1951.

A former president of General Motors Corporation and president and chairman of the Board of E. I. du Pont de Nemours and Company, Inc., Mr. Du Pont, who was 84 years old, had been senior member of a noted family of industrialists. He was born in Wilmington in 1870, studied at the William Penn Charter School in Philadelphia, and in 1890 received the degree of bachelor of science at M.I.T. After several years' experience in the manufacture of explosives, Mr. Du Pont was named treasurer of E. I. du Pont de Nemours and Company in 1902. He became chairman of the Board of directors in 1915, and during World War I was president of the firm.

In addition to his many philanthropic activities, Mr. Du Pont served in Delaware as head of the Service Citizens for the improvement of social conditions; as a member of the State Board of Education; as state liquor commissioner from 1933-1938; and as Delaware's tax commissioner from 1924-1937 and 1944-1949.

Mr. Du Pont was a member of the American Philosophical Society and Phi Beta Kappa, and received the honorary degrees of doctor of laws from Lafayette and Delaware colleges in 1922.

1954 Open House

A CAPACITY crowd of some 20,000-25,000 people is anticipated for the 1954 Open House of the Institute. This biennial event will be held on May 8, between the hours of 12:00 noon and 7:00 P.M. This year Open House falls just one week after the Massachusetts State Science Fair. It is expected that a large number of science teachers and interested students participating in the fair will attend Open House.

The program of events will include lectures, demonstrations, and exhibits by the various departments and courses at Technology. There will also be a number of exhibits by many of the student activities. Several athletic events have been planned for that day, among them a crew race with some of the Ivy League schools. A concert by the M.I.T. Concert Band will be held in the Great Court.

The committee planning the 1954 Open House is composed of both students and Faculty members. Chairman of the student committee is David L. Vogel, '54, while Faculty advisory committee chairman is Douglas P. Adams, Associate Professor of Engineering Graphics. The biennial Open House reflects the combined efforts of the entire M.I.T. family and is designed to enable the public to achieve some idea of the functions of the Institute in the community and country at large. With this in mind, the committee has come to think of Open House as portraying "Tech Men at Work and Play."

Energy and the Printed Word

RECENT progress in radically new printing processes using photographic methods for setting type, and a discussion of nuclear and solar origins as primary sources of energy for the future, were the main topics of discussion at the 302d meeting of the Alumni Council on March 29. As President of the M.I.T. Alumni Association, Horatio L. Bond, '23, presided at the dinner meeting at the Faculty Club in the Sloan Building, attended by 137 members and guests.

As Secretary for the Association, Donald P. Severance, '38, reported a change in class affiliation for one alumnus. He also reported that, between March 2 and March 24, nine members of the Faculty or of the Alumni Association, had paid visits to Alumni Clubs in 11 cities, including the following foreign cities: Buenos Aires, Monterrey, Mexico City, and Montevideo. As recorded in the opening item in this month's Institute Gazette, also reported was the fact that a conference program had been scheduled for Alumni Day, June 14. The topic of the conference will be "The Next 10 Years."

It was also reported that, as of March 24, the Alumni Fund had 8,825 contributors whose total contributions for the year thus far amounted to $195,834. In amount, this is an increase of $16,000 over the same date a year ago; in numbers, this year's showing is 141 contributors ahead of last year's showing.

At the conclusion of the business portion of the meeting, Mr. Bond called upon the two speakers of the evening to inform the Council members of recent advances in two important phases of science and technology. Samuel H. Caldwell, '25, Professor of Electrical Engineering, spoke on "Setting Type by Camera" and outlined recent advances in which electricity and photography played a significant role in printing operations. Second speaker of the evening was George R. Harrison, Dean of the School of Science. His address, "Energy of the Future – from Sun or Atom?" was devoted to a broad inquiry of the most probable sources of energy of the future.

Dr. Caldwell outlined a new method of setting type in which photography and electricity were employed in a manner that could open vast new possibilities for improvement of operations and reduction of costs in typesetting operations. Instead of setting type by means of casting hot metal into characters, letter by letter or line by line, the new technique selects, stores, and justifies lines of type by an electrically controlled photographic process. A glass-plate matrix disk contains eight concentric circles of type, each half circle comprising a different font of type. Optical systems make it possible to control the size of type so that 16 different type faces, in about a dozen different sizes of type can be produced from the same machine in any desired order or combination, without loss of time in changing from one font or type size to another. The new process is the invention of René A. Higonnet and Louis M. Moyroud, and was developed in this country by the Graphic Arts Research Foundation,

(Concluded on page 360)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

For many years the electrical industry has been asking for larger and larger generators, in order to meet the tremendous growth in demand. However, two limitations have been imposed upon generator output. One is physical size, which is limited by the dimensions of railroad tunnels and bridges. The other is the problem of heat dissipation. Temperatures within the generator must be held down to avoid damage to insulation. Cooling the stator is not too great a problem, but removing heat from the spinning rotor is not easy. In the conventional design, heat flows from the copper rotor coils through the insulation to the steel rotor body, from which it is removed by a blast of air or hydrogen.

Since the insulation is a formidable barrier to heat as well as to electricity, it became evident long ago that some way should be found to cool the rotor coils directly instead of indirectly. Various methods were tried, with varying success. New and successful designs make use of extruded copper shapes. The shapes fit together in such a manner as to form hollow copper conductors for the rotor coils.

The idea was fundamentally simple, but as is so often the case, reducing it to practicality was not easy. Some said the shapes could not be extruded. Revere, however, tackled the problem, and collaborated closely with the generator designers over a period of months. Finally all requirements were adjusted, and production began. Specifications for the shapes are tight. They are extruded, drawn, and straightened. Tolerances are close. Finish is important, since irregularities would damage the insulation. Special techniques were found to make 90-degree bends in the shapes, to complete the coils. Today generators embodying these designs are in successful operation. This is another marked advance by the electrical industry, which has consistently achieved greater efficiency, lower costs, and cheaper power.

One of the important things to remember about this development is that ways were found to overcome all handicaps. Close collaboration among many men on both sides did the trick.

If you have an idea for product improvement, or a new product, let us suggest that you search among your suppliers for advice. If one says it can't be done, perhaps another may say it can, given mutual adjustments. Just realize that the difficult is not necessarily the impossible; it may just take a little longer.

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THE INSTITUTE GAZETTE

(Concluded from page 358)

Inc. William W. Garth, '36, is president of the Foundation, and Dr. Caldwell, as director of research for the Foundation, has been responsible for developing the photon machine from the basic idea into its present commercial form. The first 10 machines to be put into use are now being completed.

Slides shown by Dr. Caldwell illustrated the precision of alignment of the characters, gave examples of composition of straight text matter, and indicated the manner in which lines could be varied in length and justified for flush margins on the right- or left-hand edges. Also illustrated was the ease with which vertical spacing can be accomplished.

Further developments being pursued or contemplated are aimed to facilitate composition of technical material including mathematical equations, composition of musical scores, composition of "difficult" ideographic languages such as Chinese, and long-distance wire transmission, using one keyboard to control the composition consoles at remote points.

In speaking on "Energy of the Future – from Sun or Atom?" Dean Harrison opened his remarks by citing the importance of energy as a factor in fixing the standard of living. Even allowing a large margin for hidden deposits, gas and oil reserves are likely to be exhausted in from 100 to 1,000 years; coal reserves are not likely to last more than 2,000 to 5,000 years at our present rate of energy consumption. At best, water power cannot supply more than a quarter of our energy needs. It is obvious, therefore, that new energy sources should be investigated, and the direct utilization of solar energy and release of nuclear energy from atoms are the most promising solutions for future energy requirements.

Although engineers are confronted with different problems in harnessing these two sources of energy, basically they are alike. The important technological problem is that of utilizing solar or nuclear energy effectively, economically, and efficiently.

On the basis of present rates for power, the solar energy reaching each square mile of the earth's surface is worth $8,000 per day, even with an energy conversion efficiency of but 4 per cent. Means for using this energy are not economically feasible at the present time, but they might become so if the efficiency of energy conversion could be increased severalfold.

In conclusion, Dean Harrison raised the question: "Will solar energy or nuclear energy be the more useful form of energy for the future?" He did not answer his question directly, but left his audience with the feeling that perhaps both would be put to good use and that, since both were basically thermonuclear reactions in the final analysis, it made little difference whether we used such energy at the high temperatures at which atomic blasts occur, or the lower temperatures with which solar energy strikes the earth's surface.

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A well filtered d-c power source is supplied, making it possible to test tubes with d-c potentials which can be accurately adjusted to correspond to actual circuit voltage operating conditions.

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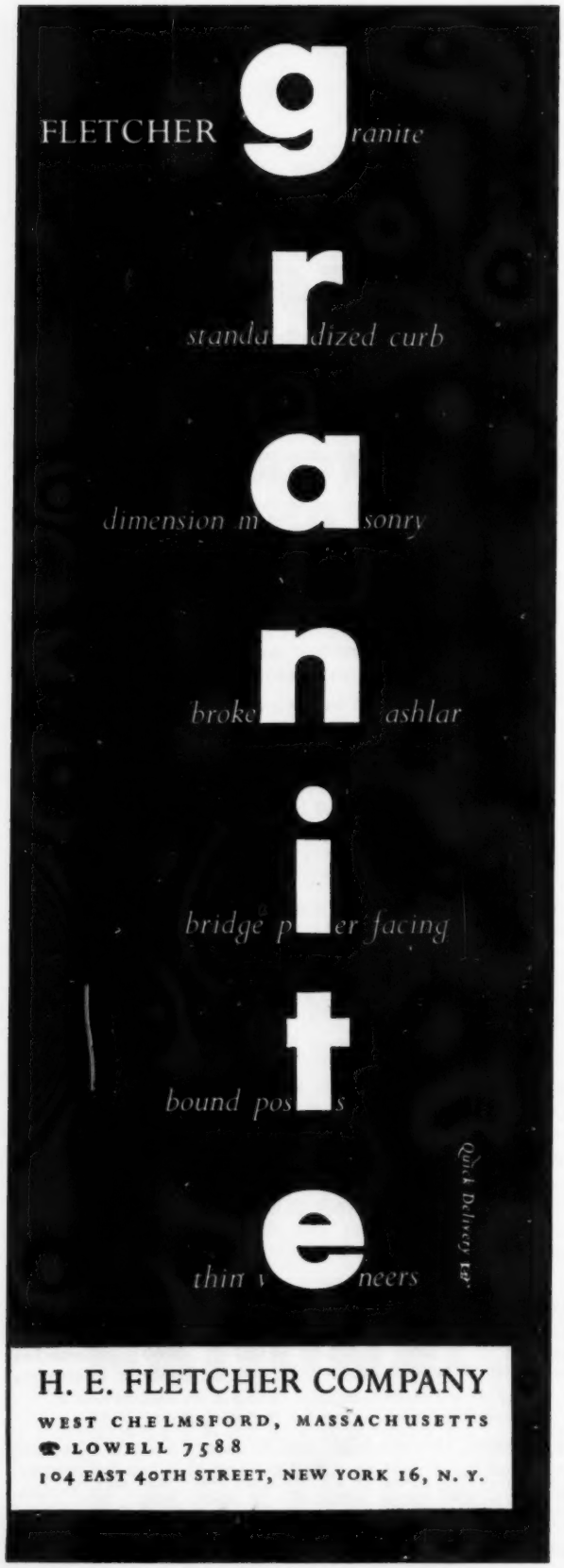

ELECTRICAL ENGINEERING IN A NEW KIND OF UNIVERSITY

(Continued from page 354)

logical conflicts, the superstitions that stand in the way of progress among vast populations in the world, the malfunctioning of our economic systems (both chronic and acute), and the fact that a large proportion of individuals are anxious, overdriven, or unhappy, even in those groups where the standard of living is high.

It would be a very desirable thing if a far larger proportion of our best brains could be diverted to research of a fundamental kind in the social, economic, and psychological sciences, instead of drifting, with the local economic winds, into the elaboration of mechanisms. It seems to me likely that the principal impact that science will make on human life during the next 50 years will not be in engineering. Such developments as atomic energy and space travel are merely the natural extrapolation of the path on which we are now moving, and are nothing radically new.

Importance of the New Understanding of Human Personality

I should imagine the big new impact will probably come from progress, now acquiring extraordinary momentum, in the field of human psychology. For the first time a coherent view of the nature of human personality is rapidly coming into focus. Like progress in many other fields, this new understanding, this flood of illumination, is coming about by the confluence of many streams that rise at diverse points.

Some of these feeder-streams have contributory sources in M.I.T. itself, as in neurology, in electroencephalography, and in those studies of group relations and psychology that are involved in any attempt to deal scientifically with problems of management. From other sources anthropologists have contributed data about the malleability of human nature, and its relationship to social tradition and to educational practices. Psychoanalysis has been revealing. Even animal psychology has given new light; it has contributed such useful concepts as innate behavior patterns, imprinting, and trigger mechanisms. Most revealing of all has been the close observation of children in the process of growing up. The main elements of personality formation, as

(Continued on page 364)

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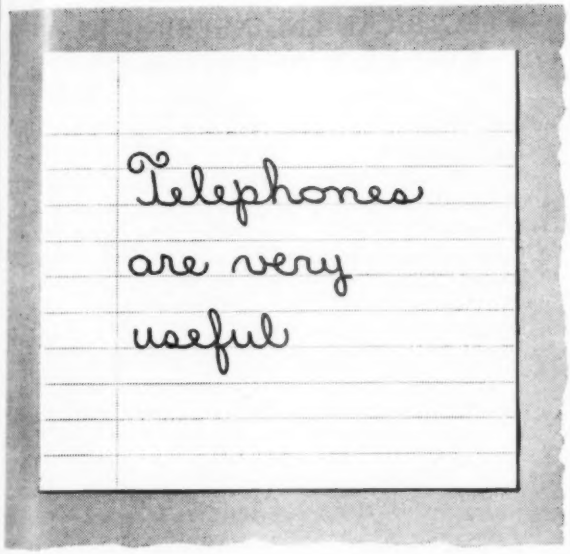
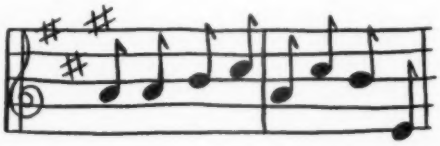


Alexander Graham Bell - inventor

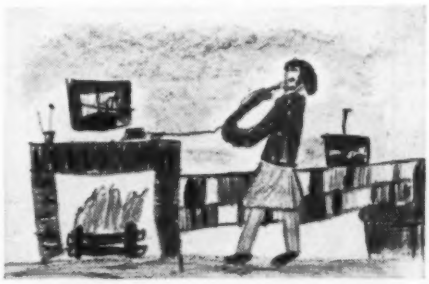
Uses of the telephone -

A. Business calls
B. Friendly calls
C. Ordering calls

1. Groceries
2. Medicines
3. Meats

Others, including military calls

(Tune - Yankee Doodle)

Telephones are very useful,
Of that we're aware.
So when you use the telephone
Just handle it with care.



When some one is in trouble you can call up people to help you. If some one is sick you can call the doctor. And if your house is on fire you call the fire department.

Some of the most interesting illustrations of the value of the telephone come from children. Here are a few, selected from many hundreds by grade-school pupils. They show imagination and a characteristic way of telling a story in a few words. Take, for instance, the words "Telephones are very useful." We couldn't sum it up better than that in a hundred years.

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ELECTRICAL ENGINEERING IN A NEW KIND OF UNIVERSITY

(*Continued from page 362*)

related to the early years of infancy, are gradually being unravelled.

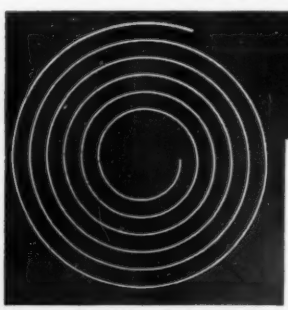
All such observations (as well as a good deal of acute logical analysis, such as in Gilbert Ryle's book, *The Concept of Mind*°) are converging to establish a broad picture. We are witnessing the beginnings of a branch of science that will be as indispensable a part of our equipment for understanding the world as quantum mechanics is in understanding semiconductors.

I am well aware that there are some persons in academic circles from whom any serious suggestion that "a proper study of mankind is man" provokes the characteristic defensive reaction of a barrage of donnish humor, delightful in its way. Psychology, we are told, is merely "the study of the Id, by the Odd": and experimental psychologists are "the men who instead of conjuring rabbits out of hats get habits out of rats." The advocate of psychology tries to retaliate by saying that, "Philosophy is the consistent misuse of a nomenclature specially devised for the purpose." Good humor is thus re-established all-around, but little progress is made. The final ditch of the objectors is to point out that at present it is impossible to staff any new department of psychology because of the extreme scarcity of psychologists of any adequate caliber. This is true, but it is clearly an argument with two edges.

I am making a plea for the inclusion of human psychology (with the status of a branch of pure science) in our university of the future. I urge something much more than the employment of men, designated psychologists, who contribute to such studies as the aiming of guns or the increase of intelligibility in telephony. Psychology has its aspects as applied science in very many fields, including education, psychotherapy, management, salesmanship; it can help solve such engineering problems as traffic control or the design of control systems. Workers in these various fields are creating their own special concepts and terminology. What they all lack is an adequate common foundation such as can be provided only when human psychology is approached as a pure science. The motive should be the search for understanding, and the need to create the vocabulary that

(*Continued on page 366*)

°New York: Barnes and Noble, Inc., 1949.



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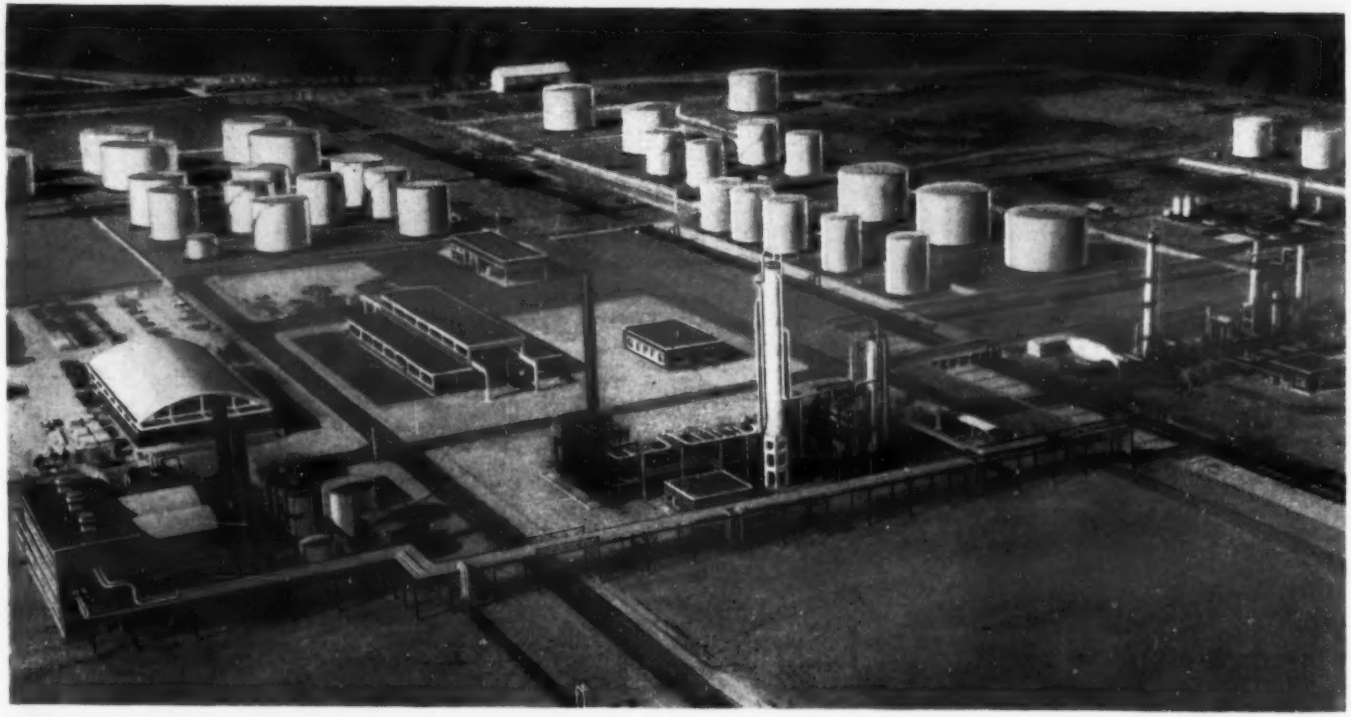

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ELECTRICAL ENGINEERING IN A NEW KIND OF UNIVERSITY

(*Continued from page 364*)

will express this understanding. Just as the various branches of engineering require physics – with its temper of unrestricted enquiry and unification – as their common background, so various activities in applied psychology should be backed by strong departments of psychology in its pure science aspect. In its aim to reach understanding of the physical world, physics claims our efforts as scientists, irrespective of particular applications. So, even more, does psychology claim our devotion as a sustained and undeterable effort to understand the world of thought and feeling.

The advancement of psychology seems to me to be indispensable because all the problems that are really important involve human motivations. It is indispensable also as an element of broader education. Already, there is a certain characteristic split between the old school – who think about human problems in the concepts of the last decade – and those who think in the light of the concepts in which human personality is now coming to be understood. The difference of outlook is more radical than that between classical physics and modern physics. One could not be satisfied if the graduates of our university of the future should be able to discuss human problems only in the language of the middle ages.

The difference between a mere institute of technical studies and our university of the modern man may lie in this unqualified and unlimited interpretation of "the application of science to human purposes" so as to include such fields as psychology and ethics. Fully accepted, I believe that such interpretation would restore the sense of integrated purpose and the ethical basis that the universities once had, but have largely lost. Purpose has drained out between the clots of specialization into which modern universities have congealed. We all strive for something, but we know not what. Our minds become split. Our intellects are active, but we lose sight of our aims.

It seems to me, as it does to many people, that this split between intellect and purpose is at the root of our present discomforts. We tend to live in two distinct worlds that we cannot yet bring into relationship. With our scientific intellects we live in a strange world of atoms and nebulae, of statistical regularity and underlying chaos; a world of evolving organisms in which man in all his aspects appears as a product of the hazards of his evolution. In this intellectual view a man's values – his likes and dislikes, his purposes, and his ideals – are seen as elaborations of behavior patterns that originated in a blind struggle for survival.

But our more intimate personal lives move in a different world of flickering purpose and inner conflict and aspiration. The evolutionary progress of man has been due, not so much to his intellect, as to those equally unique faculties and emotional mechanisms that make possible the evolution of a social tradition which guides the individual's surges of impulse into a persisting pattern for social living.

(*Continued on page 368*)

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ELECTRICAL ENGINEERING IN A NEW KIND OF UNIVERSITY

(*Continued from page 366*)

We are dimly but profoundly aware both of the necessity and the precariousness of this patterning of primary motivations, which is our morality. We tend to clutch at and defend whatever particular symbols our own society has fashioned to give it form and authority. Symbols of shadowy but permanent parent-figures sustain our particular hierarchy of good and evil and reinforce it with supernatural validity. This is man's spiritual world, where we debate a different kind of truth, in a language of symbols and in a logic that knows no syllogisms. It is with this world, more than with that of the intellect, that the educational process is chiefly concerned.

It has become a standard cliché of university oratory to distinguish between the world of science and the world of the spirit, with the implication that they are distinct and do not really interpenetrate each other. I do not think that this attitude is useful nor that it can be sustained. Split-mindedness will not do. It is a first task of a university for the modern man to clarify our approach to ethical values in the ever-brightening light of our scientific awareness, and to contribute to the evolution of an adequate formulation of ethics in the full light of the weekday teachings of science. When we take the application of science to the creation of a good society as our global theme of research, we are completely committed to clarifying what we mean by good, and so to relating the world of feelings and of valuing to the objective world of science.

This is not the place to discuss in detail how this will be achieved. Perhaps the core of the answer was expressed by the recently retired Professor of Philosophy at my own university, Professor L. Russell, who pointed out that science is concerned with *propositions* or statements about things, whereas ethics is concerned with *proposals* or suggestions that we do things. When there appears for the first time over the portal of our new university a *proposal* in simple English, "Let us build a better world," in place of some tag about the value of knowledge, then ethical education will indeed be on the way to integration with the teaching of a science school.

As a basis for educational philosophy, we must now recognize that intellect is and must be, by its very nature, a tool. What matters most are motives and purposes, and it is our business to understand them and to nurture them. Achievements in the physical sciences have made many things possible, both good and evil. The intellect is an organ of illumination, not of selection. At this stage of human progress, like travelers who have arrived through the darkness of night at some mountain hut, we watch the breaking of the scientific dawn. The light increases, the mists disappear, and the vast and intricate panorama ahead of us becomes visible; we are awed and elated. We plan our journey's next stage with the benefit of vision. But the direction of our journey and its goal are not given us by the landscape, they are choices we make. Our scrutiny and our mapmaking serve only to widen our choice of path. We must still choose whether our

(*Continued on page 370*)

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ELECTRICAL ENGINEERING IN A NEW KIND OF UNIVERSITY

(*Continued from page 368*)

path shall be to the peaks or through the swamps, whether we shall press on, or stay, or go back.

I am suggesting for your consideration, therefore, that our new university for the modern man should give priority to breadth and human development rather than to the completeness of the technical syllabus. It should have a strong department of human psychology – with the broadest interpretation of that term – and a declared and completely accepted ethical basis in its aim of discovering how science may serve more completely man's true well-being.

Electrical Engineering in the Context of the New University

The guiding principle of directing efforts into channels most needed for human welfare would fit the separate technologies into a coherent whole. It would also give new inspiration in opening up potentially fruitful fields of research. Let me illustrate this by considering the work of a department of electrical engineering in the light of this concept.

Truly great are the contributions that the advancement of electrical engineering may make to a better future. This branch of engineering puts at our command physical energy and means of communication, and both are conditions for a fuller life. The whole research and teaching activities of such a department fit into and take more significance from a master theme of social purpose. Such a master theme can widen the scope of our field of research, and divert activity from trivial to vital things. Within my own field of interest in electrical engineering may I mention, as examples, just two topics that would certainly be emphasized by such a concept of the institution's purpose.

The first is the part that electrical engineering must play in eliminating poverty and ignorance – at once a menace and a moral challenge to the more advanced communities – from vast areas in the world. In general, these areas are not poor in resources or in the innate quality of their peoples. In these areas it is physically and economically possible to create great communities where basic material needs are assured and there is enough freedom from the daily pressure of want and sickness to permit of adequate education and the assimilation of a modern outlook.

In this process the development of electric power is basic. Primary industries, such as mining and metal extraction, depend on power. Agricultural advance depends on fertilizers produced by the electrical fixation of nitrogen if power is made available.

It is pleasing to think that much of the work of the Department of Electrical Engineering at M.I.T. is already contributing to such needs while simultaneously meeting needs nearer home. Studies now in progress relate to the economical development of water power, electrical power transmission, and machinery. Consideration of the needs of the undeveloped areas does, however, provoke appraisement of the importance of many further topics. One such

(*Continued on page 372*)

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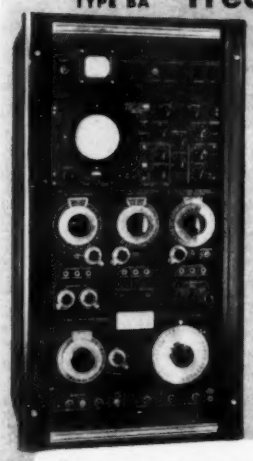

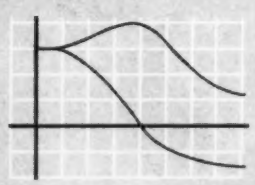

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ELECTRICAL ENGINEERING IN A NEW KIND OF UNIVERSITY

(*Continued from page 370*)

broad field is electro-chemistry, including the production of nitrogenous fertilizers, alkalies, and the electrical extracting and smelting of metals. Perhaps also a new attack should be made on the problem of converting chemical energy directly into electrical energy in the carbon cell or the like. Success in this field would circumvent that enemy of the power engineer, the second law of thermodynamics, and perhaps even make possible the use of solar energy via its fixation in tropical vegetation. Perhaps technical development might receive a new impetus by a genuine analysis of future social needs.

M.I.T. has already a nucleus of such research into the conjoint technical and economic needs of particular geographical regions in the Department of City and Regional Planning.

As a second illustration of how consideration of social needs may give new impetus to research and unite many specialists in common endeavor, may I take the problem of economic slumps and the need for a more stable working of our economies. At first sight this urgent need may seem to be outside the field of specialized contribution of an electrical engineering department, but this is not the case.

Everyone knows that great progress has been made during recent years in the creation of automatic control and automatic-regulating systems in engineering.

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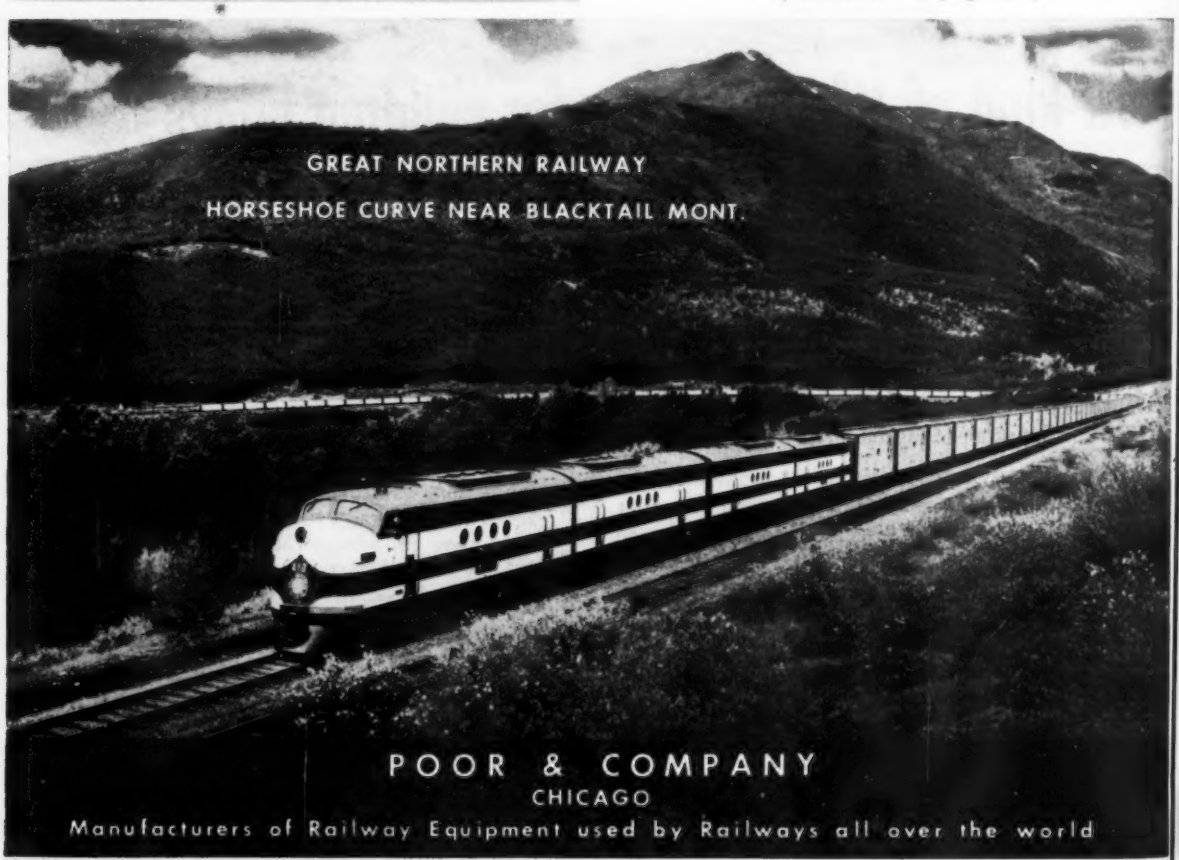
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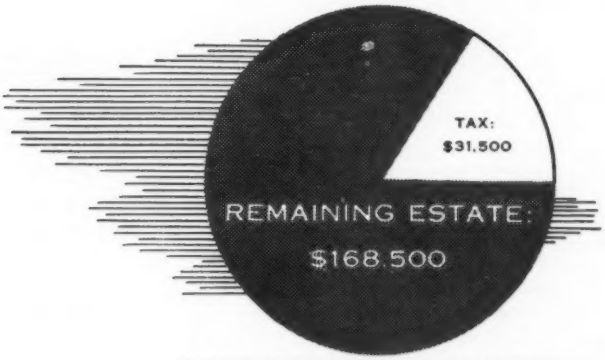

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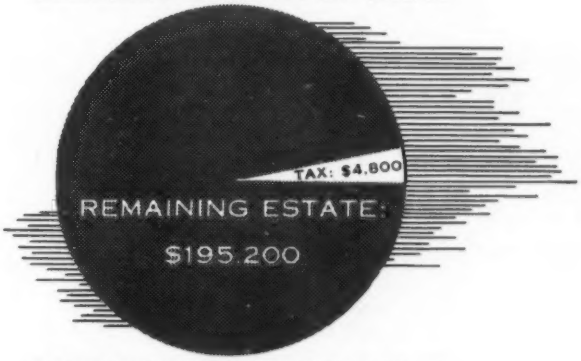

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ELECTRICAL ENGINEERING IN A NEW KIND OF UNIVERSITY

(*Concluded from page 372*)

The concepts and techniques developed by engineers and mathematicians for analyzing the behavior of such systems, do not stop short at automatic aeropilots and the regulation of nylon plants. New ideas about regulation and stability – in the development of which M.I.T. played so large a part – are now working tools of the neurologist discussing the nervous system, of the biologist discussing the fluctuations of populations. In fact, they may be applied in all those situations (including economic systems) in which many quantities interact in complex interplay.

It appears that recession and boom, as well as means for making economic activity stable and well regulated, may be analyzed by the application of the engineer's methods of system analysis, assisted by the powers of modern types of automatic computer.

Here again is the kind of example where social need suggests an effort towards a solution that would harness together a team with economists, statisticians, mathematicians, and engineers in a joint effort to make us the masters of our economic mechanisms, instead of the slaves. It is in the possibility of such joint enterprises, in which all relevant knowledge is brought together, and effort is imbued with a common social purpose, that the word "university" finds its justification.

It must be pointed out again, however, that the assembly and fusion of knowledge creates powers, but it does not ensure that men have right or agreed purposes. The discovery of good and the emergence of common purpose are functions involving knowledge but having quite other roots. They emerge in discussion, in the communication of feeling, and in the continuation of the agelong striving for expression and symbolization of our values. A university should be, above all, a furnace for this alchemy.

In conclusion, I should like to be permitted to express on behalf of us all, especially to Mrs. Webster and to other members of Mr. Webster's family, our deep sense of the services that Edwin Sibley Webster gave, not only to his country, but to the whole world, in fostering technical education. The Webster Chair will be one more enduring memorial to a great and generous personality, and I believe it will make a noteworthy contribution to the full realization of this great concept of a university of the modern man.

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ARCHITECTURE OF M. I. T.

(*Concluded from page 348*)

Danes in Denmark. Set apart by an old and traditional form of religious architecture, the chapel will be further removed from the present world by a moat which will surround the wall and reflect light from the water into the interior through arches upon which the chapel rests. A simple altar will be unadorned in keeping with the undenominational character of the chapel.

In the Institute's growth, since 1916, architects and engineers have been sensitive to the organic whole. They followed the original Bosworth scheme of creating a unified group, connecting different corridors, whenever feasible. It may not be a coincidence that the majority of architects of Technology buildings received their training at M.I.T., taught in the School of Architecture and Planning, or hold teaching positions at the present time. In addition to drawing upon its own architectural staff, the Institute has sought advice from heads of departments and other members of the faculty so that buildings could be designed with direct reference to the practical needs they were intended to serve.

Throughout the history of its building, M.I.T. has adhered to principles that have produced a unified and compact grouping of structures. From the days of its establishment in Cambridge the need for future buildings was foreseen. Additions became unobtrusive parts of the whole, while within each unit flexibility has been permitted when consistent with use. Tradition as old as Jefferson's University of Virginia has led us to accept the Roman architecture of Bosworth as proper for college buildings. The trim form of later structures that plainly denotes their function also pleases our sense of fitness. Nor are the two styles totally uncongenial; both express their purpose in simple lines, both are well proportioned and aesthetically satisfying.

IS THERE A LIMIT TO HUMAN LIFE?

(*Continued from page 350*)

tellectually, and politically may be open to question, but they certainly have matured chronologically. Today more than a quarter of our population is in the age group of 45 years or more, but in 1900 only 18 per cent was in this age category, and in 1850 only about 12 per cent. Today, as a direct result of our noteworthy accomplishments in life extension, we have more than 10,000,000 persons living at the age of 65 or over, whereas in 1900 there were only about 3,000,000 persons in this age group.

Throughout most of its history the population of the United States has been characterized by its youthfulness, but this is no longer the case. If the present rate of increase of older persons continues, as it should (barring atomic warfare or some other unforeseen disaster), the close of the present century will see more than 20,000,000 older individuals in the American population. By then the average span of life should be far beyond the proverbial three score and ten years.

(*Concluded on page 378*)

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IS THERE A LIMIT TO HUMAN LIFE?

(Concluded from page 376)

More Americans are now living longer, and possibly better, lives than their ancestors, but after they reach later middle age they do not live appreciably longer than the peoples of the past who managed to survive to this age. Most of our gains in life extension have been achieved by the prevention, or the postponement, of deaths in the earlier periods of life. This does not mean, of course, that an individual is doomed when he arrives at the age of 68, the terminus of the present average American life span, for even at that age he still has an expectancy of life of another dozen years or so, according to the tables compiled by the experts. His chances of living to or beyond 100 are, however, no better than they were in the days of the Roman Empire. At that time, incidentally, the average length of life is estimated to have been only 22 years.

Why, then, do some individuals live so much longer than others? The answer to this problem has intrigued scientists and philosophers throughout the ages, and numerous theories have been advanced to explain differences in longevity. Centenarians are, of course, always asked as to what they attribute their great ages, but invariably their answers are a bit weird, often absurd, and completely lacking in uniformity. In the olden days the few favored persons who attained to great old age undoubtedly did so through the operation of the law of the survival of the fit, but in our modern sanitary civilization the achievement of unusual old age is probably largely a matter of heredity and — luck.

If it was the custom of your ancestors to live long, your own chances of doing so are thereby enhanced, provided that you were born without any serious hampering physical defects, and that you are competent or fortunate enough to escape and avoid infections, accidents, homicide, poisons, nutritional deficiencies, mental disorders, and the numerous other hazards, perils, and casualties of our somewhat frenetic modern civilization. Heredity seems still to be the dominant factor in longevity, although it may be modified to some extent by environment.

"Father Time," wrote Charles Dickens, "is not always a hard parent, and, though he tarries for none of his children, often lays his hand lightly on those who have used him well."

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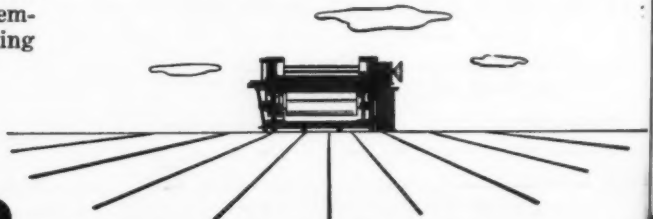

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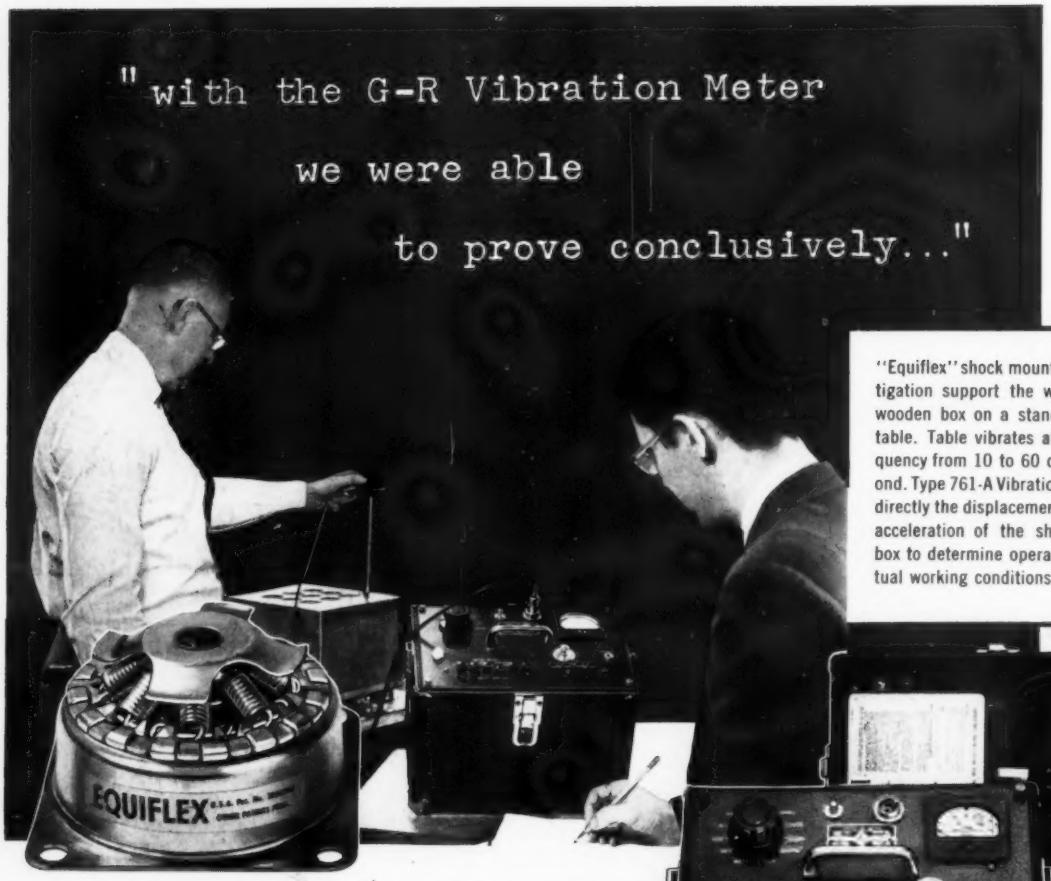

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